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(71) Applicant: FUJI MACHINE Mfg. Co., Ltd.  
Chiryu-shi Aichi-ken (JP)

(72) Inventors:  
• Takada, Yukinori, c/o Fuji Machine MFG.Co.Ltd.  
Chiryu-shi, Aichi-ken (JP)  
• Asai, Koichi, c/o Fuji Machine MFG.Co.Ltd.  
Chiryu-shi, Aichi-ken (JP)  
• Muto, Yasuo, c/o Fuji Machine MFG.Co.Ltd.  
Chiryu-shi, Aichi-ken (JP)

(74) Representative: Moir, Michael Christopher et al  
Mathys & Squire  
100 Gray's Inn Road  
London WC1X 8AL (GB)

### (54) Electric-component supplying unit

(57) An electric-component supplying unit (32) for feeding an electric-component tape which includes a carrier tape and holds a plurality of electric components at a predetermined pitch in a lengthwise direction of the carrier tape, and supplying the electric components, one by one, from the electric-component tape, the supplying unit including a frame (40) including a tape-guide portion (192) which guides the electric-component tape, a feeding device (90) which feeds, in the lengthwise direction, the electric-component tape being guided by the tape-guide portion, and positions the electric components, one by one, at a component-supply position, and the frame comprising a main frame member (42), and at least one tape-guide member (52, 269, 271) which is detachably attached to the main frame member, the main frame member and the tape-guide member attached thereto cooperating with each other to provide the tape-guide portion.

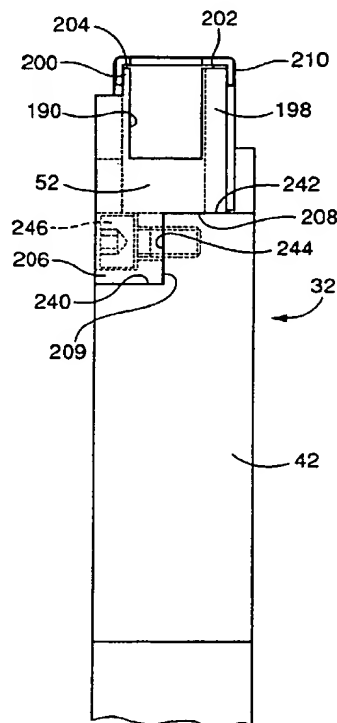


FIG. 21

## Description

### BACKGROUND OF THE INVENTION

#### Field of the Invention

[0001] The present invention relates to an electric-component supplying unit which supplies electric components (e.g., electronic components) from an electric-component tape and in particular to the art of supplying a plurality of sorts (e.g., types) of electric-component tapes.

#### Related Art Statement

[0002] There is known an electric-component ("EC") tape which includes a carrier tape and holds a plurality of electric components ("ECs") at a predetermined pitch in a lengthwise direction of the carrier tape, and an EC supplying ("EC-supply") unit which feeds the EC tape and supplies the ECs, one by one, from the EC tape. The known EC-supply unit includes a frame including a tape-guide portion which guides the EC tape; and a feeding device which feeds, in the lengthwise direction, the EC tape being guided by the tape-guide portion, and positions the ECs, one by one, at a predetermined EC-supply position where each EC is supplied to an EC receiving device as an object device.

[0003] There are known a plurality of sorts of EC tapes each of which can be supplied by the EC-supply unit and which are of different types, have different dimensions (e.g., different widths or different thicknesses), or hold ECs at different pitches (hereinafter, referred to as the "EC-hold pitch(es)") For example, there are known different types of EC tapes such as an embossed-carrier-type ("ECT") one, a punched-carrier-tape ("PCT") one, and a lead-wire-terminal-taped-type ("LWTT") one. The ECT EC tape includes (a) a carrier tape which includes a pair of widthwise opposite end portions each extending in a lengthwise direction thereof, and a plurality of embossed portions each projecting downward from between the two end portions and each accommodating one EC, and (b) a top cover tape which is adhered to the carrier tape to close respective upper openings of the embossed portions. The PCT EC tape includes (c) a carrier tape which includes (cl) a base tape which is formed of, e.g., paper or synthetic resin and which has a plurality of through-holes formed through the thickness thereof and (c2) a bottom cover tape which closes respective lower openings of the through-holes to provide a plurality of EC accommodating pockets each accommodating one EC, and (d) a top cover tape which is adhered to the carrier tape to close respective upper openings of the through-holes or the EC accommodating pockets. The LWTT EC tape may be one which includes a carrier tape which is provided by a tacky tape and which holds a plurality of ECs whose respective lead-wire terminals are adhered thereto, or one which

includes a carrier tape which includes a tacky tape and a support sheet and which holds a plurality of ECs whose respective lead-wire terminals are adhered thereto. Each type of EC tapes include different sorts of EC tapes having different widths, different thicknesses, or different EC-hold pitches.

[0004] There have been various proposals to deal with different sorts of EC tapes. For example, U.S. Patent No. 5,588,614 discloses an EC-supply unit which can supply ECs from different sorts of ECT EC tapes having different widths. The disclosed EC-supply unit employs at least one width changing block for changing the distance between two support members which can support the two end portions of the carrier tape of one sort of ECT EC tape, respectively. More specifically described, the prior EC-supply unit includes a frame, and two support rails as the two support members that are fixed to the frame and whose respective upper surfaces provide respective support surfaces which can support and guide the two end portions of the carrier tape of the one sort of ECT EC tape. One width changing block is placed in close contact with the inner side surface of one of the two support rails, so that the distance between the two fixed support rails is decreased to a value which can support the two end portions of the carrier tape of another sort of ECT EC tape having a smaller width. In the case where two or more width changing blocks having different widths are employed, the EC-supply unit can supply three or more sorts of ECT EC tapes having different widths.

[0005] The above-identified U.S. Patent No. 5,588,614 additionally discloses another EC-supply unit which includes a fixed support rail and a movable support rail which is movable toward, and away from, the fixed rail. In this case, the distance between the two support rails can be adjusted by moving the movable rail relative to the fixed rail, depending upon the width of an ECT EC tape to be supplied.

[0006] Thus, each of the EC-supply units disclosed in the U.S. patent can deal with different sorts of ECT EC tapes having different widths, but cannot deal with different types of EC tapes, e.g., two or all of the ECT, PCT, and LWTT EC tapes. Conventionally, different types of EC tapes have been dealt with by corresponding exclusive types of EC-supply units. For example, an ECT EC tape is supplied by an exclusive EC-supply unit which includes two support rails for supporting the two end portions of the carrier tape thereof and a groove provided between the two rails for allowing the embossed portions of the carrier tape to pass therethrough; and a PCT EC tape is supplied by an exclusive EC-supply which includes a support surface which supports and guides the lower surface of the bottom cover tape thereof.

[0007] Meanwhile, there is also known an EC-supply unit employing a frame which includes a cover member for preventing an EC tape from moving up off the frame. It is practiced to use the cover member to position the EC tape in the widthwise direction thereof.

[0008] However, the frame of each of the EC-supply units disclosed in the U.S. patent must have a width corresponding to the widest one of the different sorts of EC tapes which are to be supplied by the each EC-supply unit. Thus, for example, in the case where a plurality of EC-supply units are attached to a table such that respective EC-supply portions of the units are arranged along a straight line, the pitch at which the units are attached to the table must correspond to the widest one of the different sorts of EC tapes that have different widths. Therefore, even when the EC-supply units supply EC tapes having a smaller width, the pitch cannot be changed. Since, in this case, the pitch is too large and only a small number of EC tapes can be attached to the table, the efficiency of supplying of ECs is lowered.

[0009] In addition, the second prior EC-supply unit which employs the fixed and movable support rails suffers from the problem that the structure of the unit is too complex.

[0010] Moreover, in the case where different types of EC tapes are dealt with by corresponding exclusive types of EC-supply units, many types of EC-supply units must be produced and accordingly the production cost thereof cannot be lowered by mass production.

[0011] Furthermore, the third prior EC-supply unit which employs the cover member for preventing the EC tape from moving off the frame, suffers from the problem that the EC-supply unit cannot deal with different sorts of EC tapes having different EC-hold pitches. The cover member must not interfere with an EC holder which takes and holds each EC from the EC tape at the EC-supply position, but needs to cover the EC located adjacent to the each EC being taken by the EC holder on an upstream side of the each EC in the EC-feed direction. However, if the cover member is provided at a position where the cover member allows the EC holder to take each EC at the EC-supply position, irrespective of whether the EC-hold pitch of each EC tape is great or small or whether a dimension of the each EC in the EC-feed direction is great or small, the cover member may not cover the upstream EC adjacent to the each EC, in the case where the EC-hold pitch is small or the dimension of the each EC is small.

[0012] The third prior EC-supply unit suffers from another problem that the EC-supply unit cannot deal with different sorts of EC tapes having different thickness values. Here, a thickness value of an EC tape is defined as the height of the upper surface of the EC tape as measured from one or more support surface of the frame that support and guide the EC tape. In order to supply different sorts of ECs having different thicknesses, from different sorts of EC tapes having corresponding different thicknesses, respectively, the EC-supply unit must be used with each of different sorts of cover members having corresponding different thicknesses which allow the different sorts of EC tapes to be fed while being supported on the support surface or surfaces of

the frame, and which contact the respective upper surfaces of the different sorts of EC tapes to prevent the tapes from moving up off the frame. Thus, many sorts of cover members must be produced.

## SUMMARY OF THE INVENTION

[0013] It is therefore an object of the present invention to provide an electric-component supplying unit which improves at least one of the above-described proposals to deal with different sort of electric-component tapes and solves at least one of the above-indicated conventional problems.

[0014] According to a first aspect of the present invention, there is provided an electric-component supplying unit for feeding an electric-component tape which includes a carrier tape and holds a plurality of electric components at a predetermined pitch in a lengthwise direction of the carrier tape, and supplying the electric components, one by one, from the electric-component tape, the supplying unit comprising a frame including a tape-guide portion which guides the electric-component tape; a feeding device which feeds, in the lengthwise direction, the electric-component tape being guided by the tape-guide portion, and positions the electric components, one by one, at a component-supply position; and the frame comprising a main frame member, and at least one tape-guide member which is detachably attached to the main frame member and provides the tape-guide portion. The present EC supplying unit may comprise a plurality of sorts of tape-guide members corresponding to a plurality of types of EC tapes. In this case, the present EC supplying unit can supply ECs from each of the different types of EC tapes, by selectively attaching a corresponding one of the different sorts of tape-guide members to the main frame member. In addition, the present EC supplying unit may comprise a plurality of sorts of tape-guide members having different tape-guide widths corresponding to respective widths of a plurality of sorts of EC tapes. In this case, the present EC supplying unit can supply ECs from each of the different sorts of EC tapes, by selectively attaching a corresponding one of the different sorts of tape-guide members to the main frame member. Thus, the present EC supplying unit can deal with different types of EC tapes, or different sorts of EC tapes having different widths, and additionally can enjoy reduced production cost. More specifically described, as compared with the case where different sorts of EC supplying units corresponding to different sorts of EC tapes are produced, each of the different sorts of tape-guide members of the present EC supplying unit can be used with the common main frame member as a main portion thereof. Since the common main frame members can be mass-produced, each EC supplying unit can enjoy the reduced production cost. In addition, different sorts of EC supplying units can be obtained by attaching, to the single, common main frame member, each of different sorts of

tape-guide members corresponding to different types of EC tapes, or different sorts of EC tapes having different widths. Since the total number of the main frame members can be reduced, each EC supplying unit can enjoy the reduced production cost. Moreover, a plurality of present EC supplying units can be attached to a table at a smaller pitch, so that a greater number of EC supplying units can be attached to the table, as will be explained in the detailed description of the preferred embodiments.

**[0015]** The electric-component supplying unit may further comprise a positioning device which accurately positions the tape-guide member relative to the main frame member; and a fixing device which fixes the tape-guide member to the main frame member. In this case, though the tape-guide member is detachably attached to the main frame member, the tape-guide member can guide each EC tape with accuracy and stability, owing to the positioning device and the fixing device.

**[0016]** The main frame member may have at least one first positioning hole and at least one internally threaded hole which is coaxial, and continuous, with the at least one first positioning hole, the tape-guide member has at least one second positioning hole, the supplying unit further comprising at least one positioning bolt including (a) a positioning shank portion which is fitted in the first and second positioning holes to position the main frame member and the tape-guide member relative to each other, (b) an externally threaded portion which is provided at one of axially opposite ends of the shank portion and which is screwed into the internally threaded hole, and (c) a head portion which is provided at the other end of the shank portion and which is engaged with the tape-guide member, the positioning device comprising the first and second positioning holes and the positioning shank portion of the positioning bolt, the fixing device comprising the internally threaded hole, and the externally threaded portion and the head portion of the positioning bolt. In this case, since the fixing device also functions as the positioning device, the present EC supplying unit can be produced at reduced cost. The positioning bolt is preferably provided by a reamer bolt. However, it is possible that the positioning device be provided by at least one positioning pin and at least one positioning hole in which the pin can be fitted, and it is possible that the fixing device be provided by at least one bolt, and at least one bolt hole and at least one internally threaded hole with which the bolt is engaged. Alternatively, it is possible that the positioning device be provided by two first positioning surfaces of the tape-guide member that are not parallel to each other, and two second positioning surfaces of the main frame member that are not parallel to each other and that can be held in close contact with the two first positioning surfaces, respectively, so that the tape-guide member and the main frame member are positioned relative to each other. The two first or second positioning surfaces are preferably provided by a surface perpendicular to the widthwise di-

rection of the EC tape, and a surface parallel to the widthwise direction of the EC tape and the EC-feed direction in which the EC tape is fed by the feeding device. Since the first and second positioning surfaces cooperate with each other to position the tape-guide member and the main frame member to each other in two directions intersecting each other, the fixing device may be provided by at least one bolt and at least one bolt hole which have no positioning function and can be produced at low cost.

**[0017]** The at least one tape-guide member may comprise an embossed-carrier-type-electric-component-tape guide member corresponding to an embossed-carrier-type electric-component tape including a plurality of embossed portions, and a punched-carrier-type-electric-component-tape guide member corresponding to a punched-carrier-type electric-component tape, each one of the two types of tape-guide members being selectively attached to the main frame member to provide the tape-guide portion which guides a corresponding one of the two types of electric-component tapes. Each of the embossed-carrier-type-electric-component-tape ("ECT-EC-tape") guide member and the punched-carrier-type-electric-component-tape ("PCT-EC-tape") guide member can be attached to the main frame member. Thus, the present EC supplying unit can supply each of the ECT EC tape and the

**[0018]** The embossed-carrier-type-electric-component-tape guide member and the punched-carrier-type-electric-component-tape guide member may be different from each other in that the embossed-carrier-type-electric-component-tape guide member has a groove which allows the embossed portions of the embossed-carrier-type electric-component tape to pass therethrough and the punched-carrier-type-electric-component-tape guide member does not have the groove.

**[0019]** The at least one tape-guide member may comprise a plurality of sorts of tape-guide members corresponding to a plurality of sorts of electric-component tapes having different widths, respectively, each one of the plurality of sorts of tape-guide members being selectively attached to the main frame member to provide the tape-guide portion which guides a corresponding one of the plurality of sorts of electric-component tapes that has a corresponding one of the different widths. The present EC supplying unit can supply each of different sorts of EC tapes having different widths. The different sorts of tape-guide members can guide different types of EC tapes having respective different widths, respectively, or a same type of EC tapes having different widths, respectively.

**[0020]** The at least one tape-guide member may comprise a plurality of sorts of tape-guide members which include (a) respective guiding portions which are different from each other and which guide a plurality of sorts of electric-component tapes, respectively, (b) respective attachable portions which are identical with each other and each of which is attachable to the main frame mem-

ber, and (c) respective feeding-device-related portions which are identical with each other and each of which is related to the feeding device. The difference between the respective guiding portions of the different sorts of tape-guide members corresponds to, e.g., the difference between types or widths of the different sorts of EC tapes. The different sorts of tape-guide members may, or may not, have the groove according to the above feature, depending upon the different types of the different sorts of EC tapes, or may have the respective guiding portions having different widths corresponding to the different widths of the different sorts of EC tapes. In this case, each of the different sorts of tape-guide members which guide different sorts of EC tapes which are of different types and/or have different widths, can be attached to the main frame member by a common attaching device, and each of the different sorts of EC tapes can be fed by the common feeding device. That is, respective major portions of a plurality of present EC supplying units are common to each other and accordingly the EC supplying units can be mass-produced at reduced cost.

**[0021]** The plurality of sorts of tape-guide members may have the respective guiding portions in respective one side portions thereof, and have the respective attachable portions and the respective feeding-device-related portions in the respective other side portions thereof. In this case, the different sorts of tape-guide members can be easily provided with the respective attachable portions and the respective feeding-device-related portions, so as to feed different sorts of EC tapes having different widths.

**[0022]** The electric-component supplying unit may further comprise a cover member which prevents the electric-component tape from moving off the tape-guide member. the cover member may be attached to the tape-guide member or the main frame member. In this case, the cover member prevents the electric-component tape from moving off the tape-guide member. Accordingly, for example, in the case where the feeding device includes a sprocket, the projections of the sprocket are engaged with the feed holes of the EC tape, and the EC tape is fed by the rotation of the sprocket, as will be explained in the detailed description of the preferred embodiments, the cover member prevents the feed holes of the EC tape from being disengaged from the projections of the sprocket. Thus, the EC tape can be fed with reliability. In addition, in the case where an EC holder of an EC mounting system takes each EC held by the EC tape, the EC holder can take the each EC with reliability from the EC tape.

**[0023]** The cover member may be attached to the tape-guide member. In this case, the tape-guide member with the cover member attached thereto may be replaced, on the main frame member, with another tape-guide member with another cover member attached thereto. Thus, different sorts of tape-guide members can be used with different sorts of cover members suit-

able therefor, respectively, and can be replaced with each other in a short time.

**[0024]** The tape-guide member may have at least one support surface which supports and guides a lower surface of each of a plurality of sorts of electric-component tapes having respective upper surfaces whose respective heights from the support surface differ from each other, the cover member including two contact portions which contact and press, against the support surface, the each sort of electric-component tape at two locations on an upstream side and a downstream side of a place where the each sort of electric-component tape is engaged with the feeding device, in a direction in which the each sort of electric-component tape is fed by the feeding device. For example, in the case where the present EC supplying unit comprises the ECT-EC-tape guide member and the PCT-EC-tape guide member each of which is selectively attached to the main frame member depending upon a corresponding one of the ECT EC tape and the PCT EC tape to be fed, the respective upper surfaces of the two types of EC tapes may have different heights as measured from the support surface, as will be explained in the detailed description of the preferred embodiments. In this case, the cover member contacts and presses, against the support surface, each of the two types of EC tapes at two locations on the upstream and downstream sides, as seen in the tape-feed direction, of the place where the each type of EC is engaged with the feeding device, thereby effectively preventing the each type of EC tape from moving off the tape-guide member at that portion. Thus, the cover member can be used commonly for the different types of EC tapes, and accordingly the single sort, or reduced number of different sorts, of cover member, or members, can suffice. The present EC supplying unit can improve countermeasures to deal with different sorts of EC tapes whose upper surfaces have different heights from the support surface.

**[0025]** According to a second aspect of the present invention, there is provided an electric-component supplying unit for feeding each of a plurality of sorts of electric-component tapes each of which includes a carrier tape and holds a plurality of electric components at a predetermined pitch in a lengthwise direction of the carrier tape, and supplying the electric components, one by one, from the each sort of electric-component tape, the supplying unit comprising a frame having at least one support surface which supports and guides a lower surface of the each of the plurality of sorts of electric-component tapes having respective upper surfaces whose respective heights from the support surface differ from each other; a feeding device which feeds, in the lengthwise direction, the each sort of electric-component tape being guided by the support surface of the frame, and positions the electric components of the each sort of electric-component tape, one by one, at a component-supply position; and a cover member which is attached to the frame and which prevents the each sort of electric-

component tape from moving off the support surface of the frame, the cover member including two contact portions which contact and press, against the support surface, the each sort of electric-component tape at two locations on an upstream side and a downstream side of a place where the each sort of electric-component tape is engaged with the feeding device, in a direction in which the each sort of electric-component tape is fed by the feeding device. A portion of the frame that defines the support surface provides a tape-guide portion. The frame may, or may not, be separable into a main frame member and a tape-guide member. In the former case where the frame is separable into the main frame member and the tape-guide member, the tape-guide member may be replaced with another tape-guide member to deal with different sorts of EC tapes which are of different types or have different widths, as explained above

[0026] In addition, since the cover member includes the above-described two contact portions, the present EC supplying unit can deal with different sorts of EC tapes whose upper surfaces have different heights from the support surface. In the former case, the cover member may be attached to the main frame member or the tape-guide member. The difference between respective heights of respective upper surfaces of different sorts of EC tapes may result from, e.g., the difference between respective types of the different sorts of EC tapes, or respective thicknesses of the different sorts of EC tapes which are of a same type. The height of the upper surface of the ECT EC tape is equal to the thickness of the two end portions of the carrier tape thereof, and the height of the upper surface of the PCT EC tape is equal to the sum of the thickness of the carrier tape and the thickness of the top cover tape. Different sorts of EC tapes which are of the ECT but whose respective end portions have different thicknesses, have different heights; and different sorts of EC tapes which are of the PCT but whose respective base tapes hold different ECs having different heights and accordingly have different thicknesses, have different heights from the support surface. Therefore, in the case where the frame is provided by the main frame member and the tape-guide member, the EC supplying unit guides the ECT EC tape and the PCT EC tape with the exclusive ECT-EC-tape guide member and the exclusive PCT-EC-tape guide member, respectively, and the respective support surfaces of the two sorts of tape-guide members are level with each other, the respective upper surfaces of the two types of EC tapes have different heights from the respective support surfaces of the two sorts of tape-guide members. In addition, respective upper surfaces of two sorts of EC tapes which are of a same type and which have different thicknesses have different heights from the respective support surfaces of the two sorts of tape-guide members. In the case where the frame is not separable into the main frame member and the tape-guide member and the EC supplying unit guides each of the ECT EC tape and the PCT EC tape on the common sup-

port surface, or in the case where the frame is separable into the main frame member and the tape-guide member and the PCT-EC-tape guide member supports and guides the respective lower surfaces of the embossed portions of the ECT EC tape and supports and guides the bottom cover tape of the PCT EC tape, that is, in the case where a single tape-guide member is used commonly for guiding different types of EC tapes, the respective upper surfaces of the ECT EC tape and the PCT ECT tape have different heights from the common support surface because of the difference between the thickness of the ECT EC tape (i.e., the sum of the respective thicknesses of the carrier tape and the top cover tape) and that of the PCT EC tape. Also in the case where the support surface of the ECT-EC-tape guide member supports and guides the two end portions of the ECT EC tape and supports and guides the bottom cover tape of the PCT EC tape, the respective upper surfaces of the ECT EC tape and the PCT ECT tape have different heights from the common support surface because of the difference between the respective thicknesses of the ECT EC tape and the PCT EC tape. In addition, respective upper surfaces of different sorts of EC tapes which are of a same type but have different thicknesses have different heights from the common support surface. The cover member of the present EC supplying unit contacts and presses, against the support surface, each of different sorts of EC tapes whose upper surfaces have different heights from the support surface, at two locations on the upstream and downstream sides, as seen in the tape-feed direction, of the place where the each sort of EC is engaged with the feeding device, thereby effectively preventing the each sort of EC tape from moving off the tape-guide member at that portion. Thus, the present EC supplying unit can improve countermeasures to deal with different sorts of EC tapes whose upper surfaces have different heights from the support surface, and the single sort, or reduced number of different sorts, of cover member or members, or EC supplying unit or units can suffice. This leads to reducing the production cost of the EC supplying unit or units. In the case where the frame is provided by the main frame member and the tape-guide member, the cover member may be attached to the main frame member or the tape-guide member. In the former case, the cover member may prevent the moving-off of each of different types of EC tapes, or the moving-off of each of different sorts of EC tapes of a same type. In either case, the cover member contacts two portions of each EC tape to prevent the moving-off the each EC tape. In the case where a plurality of cover members are attached to a plurality of exclusive tape-guide members corresponding to different types of EC tapes, respectively, each of the cover members can prevent the moving-off of each of different sorts of EC tapes which are of a same type but have different thicknesses. Meanwhile, in the case where a single cover member is attached to a common tape-guide member used for different types of EC

tapes, respectively, the cover member can prevent the moving-off of each of the different types of EC tapes or each of different sorts of EC tapes which are of a same type but have different thicknesses.

[0027] The cover member may be attached to the frame such that the cover member is pivotable about an axis line parallel to a widthwise direction of the each sort of electric-component tape, one of the two contact portions of the cover member comprising an elastic member which is elastically deformable in a direction substantially perpendicular to the at least one support surface. The cover member may be attached to the main frame member such that the cover member can be translated in the direction substantially perpendicular to the support surface and, in this case, the cover member can easily contact and press each of different sorts of EC tapes having different thicknesses, at two locations on the upstream and downstream sides of the place where the each sort of EC tape is engaged with the feeding device. Alternatively, the cover member may be attached to the main frame member such that the cover member is pivotable about an axis line parallel to the widthwise direction of each sort of EC tape and, in this case, the cover member can be easily attached to the main frame member. However, in the latter case, when the EC supplying unit supplies different sorts of EC tapes having different thicknesses, the cover member is inclined by different angles corresponding to the different thicknesses of the different sorts of EC tapes, respectively. Thus, it is difficult for the cover member to contact and press each of the different sorts of EC tapes at two locations on the upstream and downstream sides of the place where the each sort of EC tape is engaged with the feeding device. In contrast, the present EC supplying unit is free from this problem, because one of the two contact portions of the cover member comprises the elastic member which is elastically deformable in the direction perpendicular to the support surface.

[0028] The elastic member may comprise a sheet spring including a base end portion which is connected to the cover member, and a free end portion which contacts and presses the each sort of electric-component tape.

[0029] The sheet spring may be provided by an integral portion of the cover member. Since the sheet spring is initially produced as the integral portion of the cover member, the present EC supplying unit can enjoy reduced production cost as compared with the case where the sheet spring is initially produced as a member separate from the cover member and then is fixed to the cover member. However, the sheet spring may be

[0030] According to a third aspect of the present invention, there is provided an electric-component supplying unit for feeding an electric-component tape which includes a carrier tape and holds a plurality of electric components at a predetermined pitch in a lengthwise direction of the carrier tape, and supplying the electric components, one by one, from the electric-component

tape, the supplying unit comprising a frame having a tape-guide portion which guides the electric-component tape; a feeding device which feeds, in the lengthwise direction, the electric-component tape being guided by the tape-guide portion, and positions the electric components, one by one, at a component-supply position; a cover member which is attached to the frame and which prevents the electric-component tape from moving off the frame; and a cover-member attaching device which attaches the cover member to the frame such that a position of the cover member in a tape-feed direction in which the electric-component tape is fed by the feeding device is changeable. The frame may, or may not, be separable into a main frame member and a tape-guide member. In the former case where the frame is separable into the main frame member and the tape-guide member, the cover member may be attached to the main frame member or the tape-guide member. In the latter case where the cover member is attached to the tape-guide member, the cover member may be replaced with another cover member when the tape-guide member to which the cover member is attached is replaced with another tape-guide member to which the another cover member is attached. In the former case where the cover member is attached to the main frame member, the cover member may be used commonly for different sorts of tape-guide members. The cover member may, or may not, include one or more of the aforementioned features. The position of the cover member in the tape-feed direction may be changed, for example, when ECs having a dimension in the tape-feed direction are changed, on the EC supplying unit, to a different sort of ECs having a different dimension in the same direction and accordingly an EC tape holding the ECs at a pitch is changed to a different sort of EC tape holding the different sort of ECs at a different pitch. More specifically described, in the case where the different sort of ECs have a greater dimension in the tape-feed direction, the cover member is moved in the same direction to a new position where the cover member does not interfere with the supplying of each EC from the EC tape; and in the case where the different sort of ECs have a smaller dimension in the tape-feed direction, the cover member is moved in the same direction to a new position where the cover member does not cover the leading EC to be supplied from the EC tape but covers the next EC adjacent to the leading EC on the upstream side of the leading EC in the tape-feed direction. The present EC supplying unit can change the position of the cover member in the direction parallel to the tape-feed direction and thereby supply each of different sorts of EC tapes holding ECs at different pitches while allowing each EC to be taken from the each sort of EC tape and preventing each EC from jumping off, or lying on its side on, the each EC tape. Thus, the present EC supplying unit can improve countermeasures to deal with different sorts of EC tapes which hold ECs at respective different pitches and accordingly need to be fed by respective

different distances to supply respective one ECs.

**[0031]** The cover-member attaching device may comprise a stepwise position changing device which changes the position of the cover member to each of a plurality of steps corresponding to a plurality of positions in the tape-feed direction, respectively. Since usually respective dimensions of different sorts of ECs in any direction stepwise change, the stepwise position changing device is effective in changing the position of the cover member. The stepwise position changing device can be easily operated to change the position of the cover member, and can be produced with a simple structure. However, it is possible to employ a steplessly position changing device which changes the position of the cover member steplessly, i.e., continuously.

**[0032]** The stepwise position changing device may comprise a slide member which is attached to the frame such that the slide member is movable relative to the frame in a direction parallel to the tape-feed direction; an attaching device which attaches the cover member to the slide member; a rigid engaging portion which is provided by one of the frame and the slide member; and an elastic engaging portion which is provided by the other of the frame and the slide member and which elastically engages the rigid engaging portion. In the case where the frame is provided by the main frame member and the tape-guide member and the cover member is attached to the main frame member, the rigid engaging portion is provided by one of the slide member and the main frame member, and the elastic engaging portion is provided by the other of the slide member and the main frame member. Meanwhile, in the case where the frame is provided by the main frame member and the tape-guide member and the cover member is attached to the tape-guide member, the rigid engaging portion is provided by one of the slide member and the main frame member, and the elastic engaging portion is provided by the other of the slide member and the main frame member, or alternatively the rigid engaging portion is provided by one of the slide member and the tape-guide member, and the elastic engaging portion is provided by the other of the slide member and the tape-guide member.

**[0033]** The rigid engaging portion may comprise a plurality of engaging holes which are formed in the one of the frame and the slide member such that the engaging holes are distant from each other in the tape-feed direction, and the elastic engaging portion may comprise an elastic member and an engaging projection which projects from the other of the frame and the slide member such that the engaging projection is not movable in the tape-feed direction and is movable in opposite directions in which the engaging projection engages, and disengages from, each of the engaging holes and which is biased by the elastic member in one of the opposite directions in which the engaging projection engages the each engaging hole. The elastic member may be separate from the engaging projection, or may be integral with the same. In the latter case, the engaging projection

may be provided by a projecting portion projecting from a sheet or leaf spring. The present rigid and elastic engaging portions can be produced most easily. However, it is possible that the rigid engaging portion be provided by an engaging projection and the elastic engaging portion be provided by a plurality of engaging holes, or that the rigid or elastic engaging portion be provided by a plurality of engaging projections and the elastic or rigid engaging portion be provided by a single engaging hole.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0034]** The above and optional objects, features, and advantages of the present invention will be better understood by reading the following detailed description of the preferred embodiments of the invention when considered in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic front elevation view of a circuit-board ("CB") assembling system including an electric-component ("EC") supplying system which includes a plurality of EC-supply units to each of which the present invention is applied;

Fig. 2 is a front elevation view of one of the EC-supply units;

Fig. 3 is a side elevation view of respective portions of the EC-supply units that are positioned relative to a table;

Fig. 4 is a plan view of a portion of a bucket which holds a plurality of EC-supply reels;

Fig. 5 is a plan view of a portion of an EC tape held by one of the EC-supply units;

Fig. 6 is a front elevation view of the EC tape;

Fig. 7 is a cross-sectioned, side elevation view of the EC tape;

Fig. 8 is a plan view of another sort of EC tape;

Fig. 9 is a plan view showing the state in which two EC tapes are connected to each other with a metallic connection member and a connection tape;

Fig. 10 is a front elevation view showing the state in which the two EC tapes are connected to each other with the connection member and the connection tape;

Fig. 11 is a plan view of the connection member;

Fig. 12 is a front elevation view of the connection member;

Fig. 13 is a side elevation view of the connection member;

Fig. 14 is a side elevation view of a Y-shaped projection of the connection member;

Fig. 15 is a side elevation view of an inverted-J-shaped projection of the connection member;

Fig. 16 is a partly cross-sectioned, front elevation view of a detecting head of a metal detecting device of each of the EC-supply units;

Fig. 17 is a side elevation view of the detecting head;



Fig. 18 is a plan view of the detecting head;  
Fig. 19 is a front elevation view of the EC-tape feeding device of each of the EC-supply units;  
Fig. 20 is a plan view of a front portion of each EC-supply unit;

Fig. 21 is a side elevation view of an upper portion of each EC-supply unit;

Fig. 22 is a cross-sectioned, side elevation view of each EC-supply unit, taken through a sprocket and a ratchet wheel thereof;

Fig. 23 is a cross-sectioned, side elevation view of each EC-supply unit, taken through a rotation-stop-position sensor thereof;

Fig. 24A is a front elevation view of a tape-guide member and a cover member of one of the EC-supply units, showing the state in which the cover member takes a first position relative to the tape-guide member;

Fig. 24B is a front elevation view of the tape-guide member and the cover member, showing the state in which the cover member takes a second position relative to the tape-guide member;

Fig. 25 is a cross-sectioned, side elevation view of the tape-guide member and the cover member, taken through a portion of the cover member that is connected to the tape-guide member;

Fig. 26 is a chart representing a relationship between the rotation angle of a plate cam of the EC-tape feeding device and the action, displacement, velocity, and acceleration of each of two pivotable members of the feeding device;

Fig. 27 is a front elevation view of a top-cover-tape ("TCT") treating device of one of the EC-supply units;

Fig. 28 is a cross-sectioned, side elevation view of a TCT feeding device as an element of the TCT treating device;

Fig. 29 is a partly cross-sectioned, side elevation view of the TCT feeding device;

Fig. 30 is a TCT collecting box as an element of the TCT treating device;

Fig. 31 is a diagrammatic view of a control system of the CB assembling system;

Fig. 32 is a flow chart representing a connection monitoring routine which is stored in a read only memory ("ROM") of an exclusive computer of a unit controller of each of the EC-supply units;

Fig. 33 is an illustrative view of a structure of a random access memory ("RAM") of the exclusive computer;

Fig. 34A is a side elevation view of the tape-guide member, shown in Fig. 21, which can be used with a main frame member as part of a frame of each EC-supply unit;

Fig. 34B is a side elevation view of another sort of tape-guide member which can be used with the main frame member of each EC-supply unit;

Fig. 34C is a side elevation view of yet another sort

of tape-guide member which can be used with the main frame member of each EC-supply unit;

Fig. 35 is a front elevation view of a tape-guide portion of another EC-supply unit as a second embodiment of the present invention;

Fig. 36 is a side elevation view of the EC-supply unit of Fig. 35;

Fig. 37 is a front elevation view of an embossed-carrier-type-EC-tape guide member which can be used with a main frame member of the EC-supply unit of Fig. 35;

Fig. 38 is a side elevation view of the embossed-carrier-type-EC-tape guide member of Fig. 37;

Fig. 39 is a front elevation view of a punched-carrier-type-EC-tape guide member which can be used with the main frame member of the EC-supply unit of Fig. 35;

Fig. 40 is a side elevation view of the punched-carrier-type-EC-tape guide member of Fig. 39;

Fig. 41 is a partly cross-sectioned, front elevation view of positioning holes of the main frame member of the EC-supply unit of Fig. 35;

Fig. 42 is a cross-sectioned, front elevation view showing the state in which the embossed-carrier-type-EC-tape guide member is fixed to the main frame member of the EC-supply unit of Fig. 35 with positioning bolts;

Fig. 43 is a cross-sectioned, front elevation view of a cover member of another EC-supply unit as a third embodiment of the present invention;

Fig. 44 is a front elevation view showing the state in which the embossed-carrier-type-EC-tape guide member of the EC-supply unit including the cover member of Fig. 43 guides an embossed-carrier-type EC tape;

Fig. 45 is a front elevation view showing the state in which the embossed-carrier-type-EC-tape guide member of the EC-supply unit including the cover member of Fig. 43 guides a punched-carrier-type EC tape;

Fig. 46 is a side elevation view showing the state in which the embossed-carrier-type-EC-tape guide member supports the embossed-carrier-type EC tape;

Fig. 47 is a side elevation view showing the state in which the embossed-carrier-type-EC-tape guide member supports the punched-carrier-type EC tape; and

Fig. 48 is a partly cross-sectioned, front elevation view showing the state in which the cover member of Fig. 43 prevents the embossed-carrier-type EC tape from moving off the embossed-carrier-type-EC-tape guide member.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0035] Hereinafter, there will be described, by refer-

ence to the drawings, a circuit-board ("CB") assembling system 10 including a plurality of electric-component ("EC") supplying ("EC-supply") units 32 to each of which the present invention is applied.

[0036] As shown in Fig. 1, the CB assembling system 10 includes a base 12, a print-wired-board ("PWB") conveying device 14 and an EC mounting system 16 which are provided on the base 12, and an EC supplying system 18 which can be connected to the EC mounting system 16. The EC mounting system 16 takes ECs from the EC supplying system 18, and mounts the ECs on a PWB 20 which is conveyed, and is positioned at a predetermined position, by the PWB conveying device 14. Thus, the CB assembling system 10 assembles an electric circuit on the PWB 20, i.e., a CB (circuit board). The EC mounting system 16 includes an EC sucker 22 as an EC holder that sucks each EC by applying a negative air pressure thereto; a Z-direction moving and rotating device 24 which supports the EC sucker 22 such that an axis line of the EC sucker 22 extends in a vertical direction (hereinafter, referred to as the Z direction), moves the EC sucker 22 in the Z direction, and rotates the EC sucker 22 about its axis line extending in the Z direction; and an X-Y-direction moving device 26 which supports the Z-direction moving and rotating device 24, and moves the same 24 in each of two directions perpendicular to each other in a horizontal plane (hereinafter, referred to as the X and Y directions). One of the X and Y directions that is parallel to the direction in which the PWB 20 is conveyed will be referred to as the X direction. Strictly, the PWB 20 should be called as a CB after the ECs are mounted thereon by the EC mounting system 16. However, in the present embodiment, the PWB 20 is called as the PWB as before, even after the ECs are mounted thereon. Similarly, the PWB conveying device 14 is called as before even after the ECs are mounted on the PWB 20, although the device 14 should be called as a CB conveying device.

[0037] The EC supplying system 18 includes two tables 30 (only one table 30 is shown in Fig. 1), and a plurality of EC-supply units 32 which are detachably attached to each of the two tables 30. Each of the EC-supply units 32 provides an EC supplying device. Each of the two tables 30 is mounted on a car 34, and can be moved relative to the EC mounting system 16. When the EC supplying system 18 supplies the ECs to the EC mounting system 16, each of the two cars 34 is connected by a connecting device 36 to the base 12, so that the EC supplying system 18 is connected to the EC mounting system 16. The base 12 provides a frame of the EC mounting system 16, and each of the two tables 30 is connected to the frame of the system 16 via the corresponding car 34. Thus, the EC supplying system 18 supplies the ECs to the EC mounting system 16 in the state in which the position of the system 18 is fixed relative to that of the system 16. An image taking device 38 which takes an image of each EC held by the EC sucker 22, is provided between the PWB conveying device 14 and

the EC supplying system 18.

[0038] As shown in Fig. 2, each of the EC-supply units 32 includes a frame 40 provided by a plurality of members which are integrally fixed thereto and which include a first member 42, a second member 44, a third member 46, a fourth member 48 (Fig. 17), a fifth member 50, and a sixth member 52. The first member 42 has a shape like a wide and long plate. The second member 44 has a shape like an elongate block, and is fixed to the first member 42 such that the second member 44 extends parallel to the lengthwise direction of the first member 42. The second member 44 includes a pair of first positioning projections 54 and a single second positioning projection 55. As shown in Fig. 3, each of the two tables 30 has a plurality of first positioning grooves 56 which are formed at a predetermined pitch in the X direction. Each of the EC-supply units 32 is attached to one of the two tables 30 such that the two first positioning projections 54 are fitted in one of the first positioning grooves 56 and the second positioning projection 55 is fitted in one of a plurality of second positioning grooves (not shown) of the one table 30. Thus, the each EC-supply unit 32 is positioned relative to the one table 30 in the widthwise direction of the each unit 32, i.e., in the X direction. In addition, an inclined surface 58 (Fig. 2) of a front one of the two first positioning projection 54 of the each EC-supply unit 32 engages an inclined surface (not shown) of the one table 30, so that the each unit 32 is positioned relative to the one table 30 in the lengthwise direction of the each unit 32, i.e., in the Y direction, and is prevented from moving up off the upper surface of the one table 30. Moreover, the each unit 32 is fixed to the one table 30 by a corresponding one of a plurality of unit fixing devices (not shown) which are provided corresponding to the plurality of second positioning grooves. Thus, a plurality of EC-supply units 32 are fixed to each table 30 such that respective EC-supply portions of the units 32 are arranged along a straight line parallel to the X direction, the widthwise direction of each unit 32 is parallel to the X direction, and the lengthwise direction of the each unit 32 is parallel to the Y direction. Each of the two cars 34 is supplied with electric power from the EC mounting system 16, and each of the EC-supply units 32 is supplied with electric power from a corresponding one of the two cars 34.

[0039] As shown in Figs. 5, 6, and 7, each EC-supply unit 32 supplies an EC tape 62 which holds a plurality of ECs 60. The EC tape 62 is of the embossed-carrier type, and includes a carrier tape 64 and a top-cover tape 66 which cooperate with each other to hold the ECs 60. The carrier tape 64 includes a pair of end portions 68 which are located on widthwise opposite sides of the tape 64, respectively, and which extend in the lengthwise direction of the same 64; and a number of embossed portions 70 which project downward from between the two end portions 68, at a predetermined pitch in the lengthwise direction of the tape 64. The ECs 60 are accommodated in the embossed portions 70, re-

spectively, and respective upper openings of the portions 70 are closed by the top-cover tape 66 adhered to the carrier tape 64. Each of the embossed portions 70 provides an EC accommodating pocket. Thus, the ECs 60 are held by the carrier tape 64 at a predetermined pitch in the lengthwise direction of the tape 64. The width of the top-cover tape 66 is shorter than that of the carrier tape 64, and one of the two end portions 68 of the tape 64 that is not covered by the top-cover tape 66 has a number of feed holes 74 which are formed through the thickness of the tape 64, from a top surface 72 thereof to a back surface 73 thereof, and which are arranged in an array at a predetermined pitch in the lengthwise direction of the tape 64.

**[0040]** The EC supplying system 18 can supply different sorts of EC tapes which have different widths and/or different pitches at which ECs are held by the EC tapes. For example, Fig. 8 shows a different sort of EC tape 75 which has the same width as that of the EC tape 62 but holds ECs 60 at a pitch different from that of the EC tape 62. In the present embodiment, it is assumed that the first EC tape 62 holds the ECs 60 at the smallest pitch and the second EC tape 75 holds the ECs 60 at a pitch two times longer than the smallest pitch. Other sorts of EC tapes than the first EC tape 62 have respective pitches "M" times longer than the smallest pitch. The number M is an integral number not smaller than two. The second EC tape 75 has dimensions different from those of the first EC tape 62, but has the same structure as that of the same 62. Accordingly, the same reference numerals as used for the first tape 62 are used to designate the corresponding parts of the second tape 75, in Fig. 8.

**[0041]** The EC tapes 62, 75 hold the ECs 60 whose respective widths correspond to the respective widths of the tapes 62, 75, and the EC-supply units 32 supply the EC tapes 62, 75 whose respective widths correspond to the respective widths of the units 32. That is, the wider EC tapes 62, 75 hold the wider ECs 60, and the wider EC-supply units 32 supply the wider tapes 62, 75. The predetermined pitch at which the first positioning grooves 56 are formed in the upper surface of each table 30 is somewhat greater than the smallest width of the respective widths of the EC-supply units 32. Therefore, some EC-supply units 32 whose widths are greater than the pitch of formation of the grooves 56 may be attached to the each table 30 such that the respective pairs of first positioning projections 54 of the units 32 are fitted in every second ones of the grooves 56. Thus, each table 30 can simultaneously support different sorts of EC-supply units 32 which supply different sorts of EC tapes having different widths. In the present embodiment, it is assumed that the first EC tape 62 has the smallest width of the respective widths of all the different sorts of EC tapes including the first and second EC tapes 62, 75. Thus, some EC-supply units 32 each of which supplies the first EC tape 62 holding the ECs 60 can be attached to the each table 30 at the smallest pitch

equal to the pitch of formation of the grooves 56.

**[0042]** As shown in Fig. 1, each EC tape 62, 75 is wound around a supply reel 76. Each car 34 includes a container-like bucket 78 as an integral portion thereof. Each bucket 78 provides a reel-support member, and thereby provides an EC storing device. As shown in Figs. 1 and 4, each bucket 78 has two arrays of rollers 79 each as a rotatable support member at two positions distant from each other in a front-rear direction parallel to the Y direction. The front array of rollers 79 are rotatable about a front common axis line parallel to the widthwise direction of each EC-supply unit 32, i.e., the X direction, and the rear array of rollers 79 are rotatable about a rear common axis line parallel to the X direction.

**[0043]** Each bucket 78 has three partition-plate holding members 80, 81, 82 each as a partition-member holding member. The three holding members 80, 81, 82 are supported by a front surface, a rear surface, and a bottom surface of the each bucket 78, respectively. Each of the three holding members 80, 81, 82 has a plurality of grooves 83 formed at the same pitch as that of formation of the first positioning grooves 56 of each table 30, in a direction parallel to the widthwise direction of each EC-supply unit 32, i.e., in the X direction, such that the grooves 83 are aligned with the grooves 56, respectively, with respect to the X direction. A partition plate 84 as a partition member can be fitted in each of the grooves 83 of the first one of the three holding members 80, 81, 82, a corresponding one of the grooves 83 of the second one of the three holding members 80, 81, 82, and a corresponding one of the grooves 83 of the third one of the three holding members 80, 81, 82. Each pair of partition plates 84 adjacent to each other cooperate with each other to define an inside space which can accommodate one supply reel 76. Each supply reel 76 is fitted in the inside space defined between one pair of partition plates 84, such that the reel 76 is rotatably supported on a corresponding pair of rollers 79 and is prevented from being moved in the widthwise direction thereof. Since each partition plate 84 has two recesses corresponding to the two arrays of rollers 79, the each plate 84 is prevented from being interfered with by the rollers 79.

**[0044]** Like the EC-supply units 32, the supply reels 76 supply EC tapes whose respective widths correspond to respective widths of the reels 76, and accordingly the wider reels 76 supply the wider tapes. Therefore, a plurality of partition plates 84 are attached to each bucket 78, corresponding to the respective widths of the EC tapes supplied from the supply reels 76. For example, the first EC tapes 62 each having the smallest width are supplied from the supply reels 76 each having the smallest width. In this case, the partition plates 84 are fitted in all the grooves 83 of each holding member 80, 81, 82, so as to define the smallest inside spaces for accommodating the reels 76 having the smallest width. In the case of wide supply reels 76 which cannot be accommodated in the smallest inside spaces, the partition

plates 84 may be fitted in every second ones of the grooves 83 of each holding member 80, 81, 82, so as to define respective wide inside spaces which can accommodate the wide reels 76. Thus, each bucket 78 can simultaneously accommodate different sorts of supply reels 76 having different widths. The distance between the front and rear holding members 80, 81 is greater than the outer diameter of the supply reels 76, and the intermediate holding member 82 is provided below a horizontal plane passing through the respective upper ends of the two arrays of rollers 79. Thus, the supply reels 76 are prevented from being interfered with by the three holding members 80, 81, 82. Accordingly, each supply reel 76, having either a small or large width, can be fitted in an inside space defined by two partition plates 84 and can be supported on the rollers 79, without being interfered with by any of the holding members 80, 81, 82.

[0045] A bar code 88 is printed on a side surface of each supply reel 76. In the present embodiment, the bar code 88 represents an identification number identifying a particular sort of ECs held by an EC tape supplied from the each reel 76; the dimensions of each EC; an initial number of the ECs held by the new EC tape from which no ECs have not been taken yet; the width of the EC tape; the pitch at which the ECs are held by the EC tape; and information indicating which one of the embossed-carrier type, the punched-carrier type, and the lead-wire-terminal-taped type the EC tape supplied from the each reel 76 is of.

[0046] As shown in Fig. 2, an EC tape 62 drawn from one supply reel 76 is fed by an EC-tape feeding device 90 of a corresponding EC-supply unit 32 at a predetermined pitch in the lengthwise direction of the tape 62, in a direction parallel to the lengthwise direction of the each unit 32. Thus, the ECs 60 are supplied one by one to a predetermined EC-supply position of the each unit 32, while the top-cover tape 66 is treated by a top-cover-tape ("TCT") treating device 92. The EC sucker 22 sucks an EC 60 from each embossed portion 70 of the carrier tape 64, at the EC-supply position of the each unit 32. The EC-supply position is predetermined in a front portion of the each unit 32 that is near to the PWB conveying device 14 in the front-rear direction of the each unit 32, i.e., in the lengthwise direction of the same 32. The EC-supply portion of the each unit 32 includes the EC-supply position and a portion around that position. The widthwise direction of the EC tape 62 is parallel to that of the each unit 32.

[0047] When the supplying of the ECs 60 from the EC tape 62 wound around the supply reel 76 advances and the consumption of the EC tape 62 comes near to the end, an operator replenishes a new EC tape 62. More specifically described, first, the operator removes the current supply reel 76 supplying the terminal end portion of the current EC tape 62, from the bucket 78, removes the terminal end portion of the current tape 62 from the current reel 76, sets a new supply reel 76 to supply the

new EC tape 62, to the bucket 78, and draws the initial end portion of the new tape 62 from the new reel 76. Then, as shown in Figs. 9 and 10, the operator manually connects, using a metallic connection member 100, and a connection tape 102 as another sort of connection member, the terminal end portion 96 of the current tape 62 supplying the ECs 60, to the initial end portion 98 of the new tape 62 to subsequently supply the ECs 60. The connection member 100 and the connection tape 102 cooperate with the terminal end portion 96 and the initial end portion 98 of the two EC tapes 62 to provide a connection portion 103. The operator connects the two EC tapes 62 to each other, at a position near the position where the current reel 76 supplying the current tape 62 is supported by the bucket 78. In Fig. 9, the ECs 60 are not illustrated.

[0048] As shown in Figs. 11 and 12, the tape connection member 100 includes a flat main portion 104 which is formed of a generally rectangular metal (e.g., iron) plate; a plurality of feed holes 106 (three holes 106, in the present embodiment) which are formed through the thickness of the main portion 104, at the same pitch as the pitch at which the feed holes 74 are formed in the carrier tape 64; and a plurality of caulking projections 108 (eight projections 108, in the present embodiment) which project from the main portion 104 in a direction perpendicular thereto. The main portion 104 has a width not greater than twice the distance between the center of each of the feed holes 74 of each EC tape 62 and a side edge of one of the two end portions 68 that has the feed holes 74.

[0049] Each of the caulking projections 108 has a height greater than the thickness of the carrier tape 64. In the present embodiment, the eight caulking projections 108 include two sorts of projections, i.e., four Y-shaped projections 110 two of which project from one of lengthwise opposite end portions of the main portion 104 and the other two of which project from the other end portion of the same 104; and four inverted-J-shaped projections 112 two of which project from a first intermediate portion of the main portion 104 between one pair of adjacent feed holes 106 of the three feed holes 106 and the other two of which project from a second intermediate portion of the same 104 between the other pair of adjacent feed holes 106 of the three feed holes 106. Thus, the two pairs of Y-shaped projections 110 are provided at two locations, respectively, which are distant from each other in the lengthwise direction of the main portion 104, and similarly the two pairs of inverted-J-shaped projections 112 are provided at two locations, respectively, which are distant from each other in the lengthwise direction of the main portion 104. The distance between the center of each of the opposite end feed holes 106 of the three feed holes 106 and a corresponding pair of Y-shaped projections 110 is equal to the distance between that center and a corresponding pair of inverted-J-shaped projections 112.

[0050] The two pairs of Y-shaped projections 110 are

formed by bending two pairs of projecting portions which respectively project from the lengthwise opposite ends of the main portion 104 in opposite directions parallel to the plane of the main portion 104, such that the bent projecting portions extend in a same direction perpendicular to the plane of the main portion 104, as shown in Fig. 12. Each pair of Y-shaped projections 110 are arranged in the widthwise direction of the main portion 104, as shown in Fig. 13. Each Y-shaped projection 110 includes a bifurcated upper portion 114 which gives a generally Y-shape configuration thereto. As shown in the enlarged view of Fig. 14, each Y-shaped projection 110 includes a base portion 116 having a generally trapezoidal shape. The width of the base portion 116 decreases in a direction toward the upper portion 114, which is formed within a range corresponding to the greatest width of the base portion 116.

[0051] Each inverted-J-shaped projection 112 is formed by cutting, and then bending, a portion of the main portion 104 such that the bent portion extends perpendicularly to the remaining portion of the main portion 104, as shown in Fig. 12. Therefore, the main portion 104 has four openings each having a shape corresponding to each projection 112, as shown in Fig. 11. As shown in the enlarged view of Fig. 15, each inverted-J-shaped projection 112 has a generally inverted-J-shaped configuration wherein an upper portion 118 of the each projection 112 is curved in a direction having a component parallel to the widthwise direction of the each projection 112. The upper portion 118 is formed by forming a recess 120 in an inner one of widthwise opposite end portions of the each projection 112 and forming an upper end edge 122 which is inclined such that one of widthwise opposite ends of the upper end edge 122 on the side of the inner end portion of the each projection 112 is more distant from the main portion 104 than the other end of the same 122 on the side of the other, outer end portion. The recess 122 is defined by a generally concave curve. Thus, the upper curved portion 118 is formed within a range corresponding to the width of a base portion 124 of the each projection 122. Like each pair of Y-shaped projections 110, each pair of inverted-J-shaped projections 112 are formed side by side in the widthwise direction of the main portion 104, and the two projections 112 are symmetrical with each other such that the respective upper curved portions 118 thereof project inward toward each other.

[0052] The connection member 100 is used to connect respective particular portions of the terminal and initial end portions 96, 98 of the two EC tapes 62 that correspond to the feed holes 74 of the respective carrier tapes 64. An exclusive tape connecting tool (not shown) is used by the operator to caulk the caulking projections 108 of the connection member 100 and thereby connect the two EC tapes 62 to each other. This tape connecting tool is disclosed in U.S. Patent Application No. 09/108,243. The tape connecting tool has a plurality of positioning projections on which first the feed holes 106

of the connection member 100 are fitted and then the feed holes 74 of the terminal and initial portions 96, 98 of the two EC tapes 62 are fitted. Thus, one of the lengthwise opposite end feed holes 106 of the connection member 100 is aligned with one of the feed holes 74 of the terminal end portion 96 of the current EC tape 62, the other end feed hole 106 of the connection member 100 is aligned with one of the feed holes 74 of the initial end portion 98 of the new EC tape 62, and the intermediate feed hole 106 of the connection member 100 is aligned with respective semi-circular feed holes 74 of the two end portions 96, 98. Each pair of inverted-J-shaped projections 112 are positioned between the semi-circular feed holes 74 and a corresponding one of the respective complete feed holes 106 of the two EC tapes 62, and each pair of Y-shaped projections 110 are positioned between the two complete feed holes 106 of a corresponding one of the two EC tapes 62.

[0053] When in the above-indicated state the operator operates the tape connecting tool, first, the Y-shaped projections 110 and the inverted-J-shaped projections 112 substantially completely penetrate through the respective carrier tapes 64 of the two EC tapes 62 and project out of the respective top surfaces 72 of the carrier tapes 64. Then, the upper bifurcated portions 114 of each pair of Y-shaped projections 110 and the upper curved portions 118 of a corresponding pair of inverted-J-shaped projections 112 are bent toward each other. Consequently the main portion 104 is closely contacted with the respective back surfaces 73 of the two carrier tapes 64, and the upper portions 114, 118 are closely contacted with the respective top surfaces 72 of the carrier tapes 64, and cooperate with the main portion 104 to sandwich the respective end portions of the two carrier tapes 64 and thereby reliably connect the terminal and initial end portions 96, 98 of the two EC tapes 62 to each other.

[0054] After the respective carrier tapes 64 of the two EC tapes 62 are connected to each other by the connection member 100, the respective top-cover tapes 66 of the terminal and initial end portions 96, 98 of the two EC tapes 62 are connected to each other with the connection tape 102 which is formed of a synthetic resin, as shown in Figs. 9 and 10. The connection tape 102 has a tacky material applied to one of opposite major surfaces thereof, and the operator adheres the connection tape 102 to the respective top-cover tapes 66 of the current and new EC tapes 62.

[0055] Each of the third and fourth members 46, 48 as the two elements of the frame 40 of each EC-supply unit 32 has a shape like a thin plate, as shown in Fig. 17. The third and fourth members 46, 48 cooperate with each other to sandwich the first member 42 in the widthwise direction of the each unit 32, and are fixed to the first member 42. A rear end of the third member 46 that is distant from the first member 42 and is near to the corresponding supply reel 76 supports a guide roller 140 as a rotatable guide member, via a lever 142, such that

the guide roller 140 is rotatable about an axis line parallel to the widthwise direction of the EC tape 62. The EC tape 62 drawn from the supply reel 76 is engaged with the guide roller 140, and is fed forward while being prevented from being moved in the widthwise direction thereof by a pair of flanges 146 of the roller 140 (only one flange 146 is shown in Fig. 16).

[0056] A detecting head 152 of a metal detecting device 150 as a connection detecting device is provided adjacent to, and on a downstream side of, the guide roller 140 in the direction in which the EC tape 62 is fed (hereinafter, referred to as the "EC-feed direction"). The detecting head 152 includes a block-like main member 156 which is fitted in a space defined between the third and fourth members 46, 48, and is fixed to those members 46, 48 such that the main member 156 can be detached from the same 46, 48. The main member 156 includes an upper end portion which projects upward from the third and fourth members 46, 48 and which has a shallow groove 158 and a deep groove 160. The shallow groove 158 extends parallel to the EC-feed direction and has a width slightly greater than that of the carrier tape 64. The deep groove 160 opens in the bottom of the shallow groove 158, has a width smaller than that of the shallow groove 158, and allows the embossed portions 70 of the EC tape 62 to pass therethrough. The deep groove 160 is provided at a position biased toward the fourth member 48 relative to the shallow groove 158. The shallow groove 158 has a pair of support surfaces 162, 163 which support and guide the pair of end portions 68 of the EC tape 62, respectively. The one support surface 162 on the side of the third member 46 has a greater width, and supports and guides the one end portion 68 having the feed holes 74. The other support surface 163 on the side of the fourth member 48 has a smaller width, and supports and guides the other end portion 68 free of the feed holes 74. Each of the support surfaces 162, 163 has two inclined surfaces 164 which are formed in opposite end portions thereof as seen in the EC-feed direction, respectively, such that each of the two inclined surfaces 164 is inclined downward in a direction toward a corresponding one of the opposite ends of the each surface 164. The front and rear inclined surfaces 164 of the support surfaces 162, 163 guide the end portions 68 of the EC tape 62, when each portion of the tape 62 enters and quits the metal detecting device 150.

[0057] Two electrodes 166 are fixed by respective fixing devices (not shown) to two side surfaces of a particular portion of the main member 156, respectively, that corresponds to the wide support surface 162. The two side surfaces are distant from each other in the EC-feed direction. Each of the two fixed electrodes 166 extends in a vertical direction, and can be detached from a corresponding one of the two side surfaces. As shown in Figs. 16 and 17, respective upper portions of the two electrodes 166 are bent, along the wide support surface 162, toward each other with a predetermined space be-

ing left therebetween. Thus, the two electrodes 166 are distant from each other on a path along which the connection member 100 is moved when the EC tapes 62 are fed forward, and cooperate with the wide support surface 162 to support the one end portion 68 having the feed holes 74. When the connection member 100 passes over the two electrodes 166, the connection member 100 can simultaneously contact both of the two electrodes 166 and thereby electrically connect the same 166 to each other.

[0058] The two electrodes 166 of the detecting head 152 are connected via a wiring 167 to a connection detecting circuit 168 (Fig. 31). The detecting head 152 and the detecting circuit 168 cooperate with each other to provide the metal detecting device 150. Thus, the metal detecting device 150 is a sort of contact-type sensor. In the state in which the two electrodes 166 are electrically connected to each other, the connection detecting circuit 168 produces a first signal; and in the state in which the two electrodes 166 are not connected to each other, the detecting circuit 168 produces a second signal different from the first signal. Usually, the two electrodes 166 are not connected to each other. When the metallic connection member 100 connecting between the two EC tapes 62 passes over the two electrodes 166, the two electrodes 166 are electrically connected to each other via the connection member 100. From the first or second signal supplied from the metal detecting device 150 or the connection detecting circuit 168 thereof, a unit controller 500 (Fig. 31) recognizes that the connection member 100 is passing over the two electrodes 166, and thereby detects the connection member 100 or the connection portion 103.

[0059] After the EC tape 62 is guided by the guide roller 140, the two end portions 68 thereof are supported and guided by the wide support surface 162 (and the two electrodes 166) and the narrow support surface 163, respectively, while the embossed portions 70 thereof enter the groove 160 and move in the same 160. One of the two end portions 68 that has the feed holes 74 is pressed against the two electrodes 166 by a pressing roller 170 as a pressing member that is attached to the fifth member 50 fixed to the third member 46.

[0060] As shown in Fig. 17, the fifth member 50 has a shape like a thin plate, and a lever 172 is attached to a rear end portion of the fifth member 50 such that the lever 172 is pivotable about an axis line perpendicular to the EC-feed direction. The pressing roller 170 is attached to the lever 172 such that the roller 170 is rotatable about an axis line parallel to the axis line of pivotal motion of the lever 172. The lever 172 is biased by a spring member 174 as an elastic member as a sort of biasing device that is provided between the lever 172 and the fifth member 50, so that the pressing roller 170 is biased in a direction toward the two electrodes 166. Thus, the pressing roller 170 presses the EC tape 62 or the carrier tape 64 against the electrodes 166. When the connection member 100 passes over the two electrodes

166, the pressing roller 170 presses the connection member 100 against the electrodes 166, so that the two electrodes 166 are reliably electrically connected to each other via the connection member 100. Thus, the unit controller 500 surely detects the connection portion 103 of the two EC tapes 62.

[0061] The lever 172 includes an operable portion 176 which is manually operable by the operator for pivoting the lever 172 against the biasing force of the spring member 174, so that a space is produced between the pressing roller 170 and the electrodes 166 and an end portion of an EC tape 62 can be manually put in that space. After the end portion of the EC tape 62 is sandwiched between the pressing roller 170 and the main member 156 of the detecting head 152, the operator releases the operable portion 176, to allow the pressing roller 170 to press the one end portion 68 having the feed holes 74, against the electrodes 166.

[0062] As shown in Figs. 16 and 18, an upper portion of the fourth member 48 is bent perpendicularly toward the third member 46, so that an upper surface of the bent upper portion of the fourth member 48 provides a horizontal support surface 180 which extends in the lengthwise direction of the each EC-supply unit 32 and which supports and guides respective bottoms of the embossed portions 70 of the EC tape 62. One of opposite end portions of the support surface 180 that is nearer to the detecting head 152, i.e., an upstream-side one of the opposite end portions as seen in the EC-feed direction has a guide surface 182 which is inclined downward in a direction toward the head 152. The EC tape 62, after having passed through the detecting head 152, moves on the support surface 180. The EC tape 62 moving on the support surface 180 is prevented, by the respective frames of two EC-supply units 32 adjacent to the each EC-supply unit 32, from moving in the widthwise direction of the tape 62.

[0063] After the EC tape 62 is supported and guided by the support surface 180, the tape 62 is guided by the sixth member 52 which has a groove 190 in a front portion of the each EC-supply unit 32. As shown in Figs. 19 and 21, the sixth member 52 has a shape like an elongate block, and is detachably attached to the front portion of the first member 42. The first member 42 provides a main frame member; the sixth member 52 provides a tape-guide member; and the sixth member 52 attached to the first member 42 provides a tape-guide portion 192 of the EC-supply unit 32.

[0064] The groove 190 extends in the lengthwise direction of the sixth member 52, i.e., parallel to the EC-feed direction. As shown in Fig. 21, the groove 190 has a width and a depth which allow the embossed portions 70 to pass therethrough. The groove 190 is defined by a pair of side walls which provide a pair of support rails 198, 200, respectively. The two support rails 198, 200 has respective upper end surfaces which provide respective support surfaces 202, 204 which support and guide the respective lower surfaces of the two end por-

tions 68 of the EC tape 62. The first support surface 202 is wider than the second support surface 204, and supports the one end portion 68 having the feed holes 74. The second support surface 204 supports the other end portion 68 free of the feed holes 74.

[0065] As shown in Figs. 21 and 24 (24A and 24B), lengthwise opposite end portions of the sixth member 52 have respective legs 206. As shown in Fig. 21, the legs 206 are provided at respective locations distant from the first support surface 202 in the widthwise direction of the sixth member 52. The sixth member 52 has two positioning surfaces 208, 210 which are perpendicular to each other.

[0066] A cover member 210 is attached to the sixth member 52, and prevents the EC tape 62 from moving up off the support surfaces 202, 204. As shown in Fig. 21, the cover member 210 has a generally inverted-U-shaped cross section and, as shown in Fig. 20, a top wall of the cover member 210 covers almost all portions of the groove 190 and the support surfaces 202, 204. The cover member 210 has an opening 212 through which each EC 60 is taken by the EC sucker 22 of the EC mounting system 16.

[0067] The cover member 210 is attached to the sixth member 52 such that the cover member 210 is movable in the lengthwise direction of the sixth member 52, i.e., in opposite directions parallel to the EC-feed direction. Thus, the position of the cover member 210 relative to the frame 40 including the sixth and first members 52, 42 can be changed in the directions parallel to the EC-feed direction. A slide member 214 is movably or slidably fitted in an elongate hole 216 which is formed in the sixth member 52 such that the elongate hole 216 extends parallel to the EC-feed direction. As shown in Fig. 25, an axis member 218 is fitted in a front portion of the slide member 214 such that the axis member 218 extends perpendicularly to the EC-feed direction, i.e., parallel to the widthwise direction of the EC tape 62. Opposite end portions of the axis member 218 project out of the slide member 214 on both sides of the sixth member 52, and respective lengthwise intermediate portions of a pair of side walls of the cover member 210 are pivotally fitted on the projecting end portions of the axis member 218, respectively. Thus, the cover member 210 is attached to the sixth member 52 such that the cover member 210 is pivotable about an axis line parallel to the widthwise direction of the EC tape 62. The axis member 218 also functions to attach the slide member 214 to the sixth member 52 and attach the cover member 210 to the slide member 214. The sixth member 52 has two elongate holes 220, shown in Figs. 24 and 25, which prevent the axis member 218 from being interfered with by the sixth member 52 when the cover member 210 and the slide member 214 are moved with each other.

[0068] A lengthwise intermediate portion 222 of the slide member 214 has a great width, as shown in Figs. 20 and 23, and a rear portion of the cover member 210 is engaged with the wide portion 222. As shown in Fig.



23, the wide portion 222 has a through-hole 224 which is formed through the thickness of the slide member 214 in the widthwise direction thereof. A pair of engaging pins 226 each as an engaging member are fitted in axially opposite end portions of the through-hole 224, respectively, such that the two pins 226 are oriented in opposite directions, respectively, and a spring member 228 biases the two pins 226 in those opposite directions, respectively, i.e., in respective directions in which the two pins 226 project out of the through-hole 224. Each pin 226 has a stepped shape, and a large-diameter engaging portion 230 of the each pin 226 is fitted in an engaging hole 232 of the cover member 210. Thus, the cover member 210 is attached to the wide portion 222 of the slide member 214. Fig. 24 shows a recess 234 which is continuous with each engaging hole 232 of the cover member 210 and which has a width smaller than the diameter of the each engaging hole 232. Thus, when the operator pivots the cover member 210 in the state in which the engaging pins 226 are retracted into the through-hole 224 against the biasing force of the spring member 228 and respective small-diameter portions 236 of the two pins 226 are positioned in the respective engaging holes 232, the cover member 210 can be disengaged from the pins 226 and can be pivoted about the axis member 218. Fig. 24 also shows a recess 238 of the sixth member 52 that allows the wide portion 222 to be moved relative to the sixth member 52. The limit of movement of each engaging pin 226 due to the biasing action of the spring member 228 is defined by a movement-limit defining member (not shown). Thus, the pins 226 are prevented from coming off the through-hole 224, which means that the movement-limit defining members also function as coming-off preventing members.

**[0069]** As shown in Figs. 19 and 21, the first member 42 has two recesses 240 at two locations distant from each other in the lengthwise direction thereof. The sixth member 52 is placed on the first member 42 such that the legs 206 of the sixth member 52 are fitted in the recesses 240 of the first member 42, the first positioning surface 208 is contacted with an upper surface 242 of the first member 42, and the second positioning surface 209 is contacted with a recess-defining surface 244 of the first member 42. Thus, the sixth member 52 is accurately positioned relative to the first member 42, both in the widthwise direction of the each EC-supply unit 32 and in a vertical direction perpendicular to the widthwise and lengthwise directions of the same 32. Bolts 246 each as a fixing device are used to attach the sixth member 52 to the first member 42 such that the sixth member 52 is detachable from the first member 42. The upper surface 242 and the recess-defining surface 244 of the first member 42 function as positioning surfaces which position the sixth member 52 relative to the first member 42, and cooperate with the positioning surfaces 208, 209 to provide a positioning device. The second positioning surface 209 also functions as a reference plane

which defines a position of the sixth member 52 relative to the first member 42 in the widthwise direction of the each EC-supply unit 32.

**[0070]** In addition, since the downstream-side leg 206 of the sixth member 52 as seen in the EC-feed direction is contacted with an end surface 247 of the downstream-side recess 240 of the first member 42, the sixth member 52 is positioned relative to the first member 42 in the EC-feed direction. The upstream-side recess 240 as seen in the EC-feed direction has dimensions which allow, in the state in which the sixth member 52 is thus positioned relative to the first member 42, the upstream-side leg 206 of the sixth member 52 to be fitted therein. A portion of the sixth member 52 that defines the positioning surfaces 208, 209 provides an attachment portion which is attached to the first member 42 as the main frame member. A portion of the sixth member 52 that includes the support rail 198 having the wide support surface 202 supporting the one end portion 68 having the feed holes 74, provides a portion of the sixth member 52 that corresponds to the EC-tape feeding device 90, or a sprocket 272 (described later) as an element of the feeding device 90. The sixth member 52 has both the attachment portion and the portion corresponding to the EC-tape feeding device 90, in the same half portion thereof as seen in the widthwise direction thereof.

**[0071]** In the state in which the sixth member 52 is fixed to the first member 42, a screw 252 is screwed with the first member 42 such that the screw 252 extends through a through-hole 248 (Fig. 24) formed through the thickness of the sixth member 52, and through an elongate hole 250 (Fig. 20) of the slide member 214. Thus, as shown in Fig. 19, the slide member 214 is fixed to the first member 42 in the state in which a head portion 254 of the screw 252 as a fixing device and a moving-off preventing device prevents the slide member 214 from moving off the first member 42.

**[0072]** Before the slide member 214 is fixed to the first member 42, the position of the cover member 210 in the directions parallel to the EC-feed direction is adjusted. As shown in Figs. 20 and 24, a rear portion of the slide member 214 has a plurality of conical holes 256 at a regular interval of distance in the lengthwise direction of the sixth member 52. Since a ball 260 of a ball plunger 258 of the first member 42 is fitted in one of the conical holes 256, the slide member 214 is positioned relative to the first member 42, and accordingly the cover member 210 is positioned relative to the first member 42. The slide member 214 has a plurality of center holes, and respective opening end portions of the center holes define the conical holes 256. As shown in Fig. 19, the ball plunger 258 includes a cylindrical casing 262 which has an externally threaded outer circumferential surface and which accommodates the ball 260, and a spring member 264 which biases the ball 260 in a direction in which the ball 260 projects out of the casing 262. The casing 262 is screwed with the first member 42. The movement of the slide member 214 is allowed by the retraction of



the ball 260 into the casing 262 against the biasing force of the spring member 264 and the disengagement of the ball 20 from one conical hole 256. When the ball 260 is engaged with another conical hole 256, the slide member 214 or the cover member 210 is positioned relative to the first member 42.

[0073] The position of the cover member 210 relative to the frame 40 including the first member 42 and the sixth members 42, 52 can be changed in the same number of steps as the number of the conical holes 256, for example, to one position shown in Fig. 24A and another position shown in Fig. 24B. The position of the cover member 210 is changed in those steps depending on a dimension of the ECs 60 as seen in a direction parallel to the EC-feed direction, i.e., depending on a pitch at which the ECs 60 are held by the EC tape 62. Whichever position the cover member 210 may take, the cover member 210 does not cover each EC 60 being fed to the EC-supply position, thereby allowing the each EC 60 to be taken from the embossed portion 70, but covers the next or adjacent EC 60 on the upstream side of the each EC 60 being at the EC-supply position.

[0074] The cover member 210 is attached together with the sixth member 52 to the first member 42, in the state in which the cover member 210 is attached to the sixth member 52. After the sixth member 52 is attached to the first member 42, the cover member 210 is moved in the EC-feed direction to a position corresponding to the pitch at which the ECs 60 are held by the EC tape 62 (hereinafter, referred to as "the EC-hold pitch"). In the state in which the ball 260 of the ball plunger 258 is engaged with one conical hole 256 and the sixth member 52 is positioned relative to the first member 42, the screw 252 is screwed with the first member 42 through the elongate hole 250, and thus the slide member 214 or the cover member 210 is fixed to the first member 42 in the directions parallel to the EC-feed direction. Therefore, even if vibration may be input to the each EC-supply unit 32, the cover member 210 is not moved out of position relative to the first member 42. Even in this state, the cover member 210 can be disengaged from the slide member 214 and pivoted about the axis member 218.

[0075] When the operator sets an initial end portion of an EC tape 62 on the sixth member 52, first, the cover member 210 is removed from the engaging pins 226, is pivoted about the axis member 218, and is moved away from the sixth member 52. Next, the embossed portions 70 of the EC tape 62 are fitted in the groove 190, so that the two end portions 68 are placed on the two support surfaces 202, 204, respectively, and the feed holes 74 are engaged with projections of the sprocket 272 described later. Then, the cover member 210 is pivoted to cover the EC tape 62, while the pins 226 are retracted into the through-hole 224 against the biasing force of the spring 228 to a position where the respective small-diameter portions 236 of the pins 226 are aligned with the respective recesses 234 of the cover member 210.

After the cover member 210 is pivoted and the small-diameter portions 236 are fitted in the respective engaging holes 232 through the respective recesses 234, the operator releases the pins 226. Thus, the engaging portions 230 are engaged with the respective engaging holes 232 because of the biasing action of the spring member 228, and the cover member 210 is attached to the slide member 214. In this state, the cover member 210 cannot be pivoted. Therefore, when the top-cover tape 66 is peeled from the carrier tape 64, the cover member 210 cannot be moved. The EC tape 62 is prevented from moving in the widthwise direction thereof, because the embossed portions 70 thereof are fitted in the groove 190 and because the two end portions 68 thereof are prevented from moving in the widthwise direction thereof, by the two side walls of the cover member 210.

[0076] After the sixth member 52 and the cover member 210 are thus fixed to the first member 42, the position of the cover member 210 is changed when the current sort of EC tapes 60 are changed to another sort of EC tapes 75. In this situation, the operator loosens the screw 252 and thereby unfastens the cover member 210 from the first member 42. Then, the operator grasps the cover member 210, and moves the slide member 214 or the cover member 210 while retracting the ball 260 of the ball plunger 258 into the casing 262 against the biasing force of the spring member 264 and thereby disengaging the ball 260 from one conical hole 256. Though the screw 252 is not removed from the first member 42, the movement of the slide member 214 relative to the screw 252 (i.e., the first member 42) is allowed by the elongate hole 250.

[0077] The cover member 210 is re-positioned relative to the first member 42, when the ball 260 is engaged with another conical hole 256 and the slide member 214 is positioned again relative to the first member 42. After this re-positioning of the cover member 210, the operator re-fastens the screw 252 and thereby fixes the cover member 210 to the first member 42 in the directions parallel to the EC-feed direction. In the present embodiment, the engaging pins 226 and the engaging holes 232 cooperate with each other to provide an attaching device which attaches the cover member 210 to the slide member 214; the slide member 214, the conical holes 256 as engaging recesses as a sort of stationary engaging portions, the ball 260 as an engaging projection as a sort of elastic engaging portion, and the spring member 264 cooperate with each other to provide a stepwise position changing device 266; and the stepwise position changing device 266 cooperates with the axis member 218 and the elongate holes 220 to provide a cover attaching device 268.

[0078] When the cover member 210 is moved to change its position in the directions parallel to the EC-feed direction, the axis member 218 is also moved together with the cover member 210 and the slide member 214. Accordingly, at any position, the cover member 210

can be pivoted about the axis member 218, so that an EC tape 62 can be set on the each EC-supply unit 32.

**[0079]** The first member 42 as the main frame member can be used with each of different sorts of tape-guide members having different widths. The above-described sixth member 52, shown in Fig. 34A, is one of those tape-guide members. Figs. 34B and 34C show two other sixth members 269, 271 as two other tape-guide members that have different widths each different from that of the first sixth member 52. Respective grooves 190 of the three sixth members 52, 269, 271 each of which allows the passing of embossed portions 70 of a carrier tape 64 have different widths, and respective legs 206 of the same 52, 269, 271 have different widths. Here, the width of each groove 190 or each leg 206 is defined as a dimension thereof as measured in a direction parallel to the width of each sixth member 52, 269, 271. However, except those differences, the three sixth members 52, 269, 271 have an identical structure, and accordingly the same reference numerals as used in describing the sixth member 52 are used to designate the corresponding elements of each of the two other sixth members 269, 271.

**[0080]** Respective support rails 198 of the three sixth members 52, 269, 271 that define respective support surfaces 202 have a same width. Each support surface 202 supports and guides the bottom of one end portion 68 of a carrier tape 64 that has the feed holes 74. In addition, the respective support rails 198 of the three sixth members 52, 269, 271 have a same position relative to corresponding positioning surfaces 209 of the same 52, 269, 271 that position the same 52, 269, 271 relative to the first member 42 in the widthwise direction of the same 52, 269, 271. As indicated above, the respective grooves 190 of the three sixth members 52, 269, 271 have different widths, that is, the three sixth members 52, 269, 271 have different distances between the two support surfaces 202, 204. Thus, the three sixth members 52, 269, 271 have different EC-tape guiding portions. However, the three sixth members 52, 269, 271 have identical attachable portions which are attachable to the first member 42, and have identical feeding-device-related portions which are related to the EC-tape feeding device 90 supported by the first member 42. The different EC-tape guiding portions of the three sixth members 52, 269, 271 are opposite to the identical attachable portions and the identical feeding-device-related portions of the same 52, 269, 271, as seen in the widthwise direction of the same 52, 269, 271.

**[0081]** Each of the two other sixth members 269, 271 is attached to the first member 42, in the same manner as that in which the sixth member 52 is attached to the first member 42. More specifically described, first, the positioning surface 208 of the each sixth member 269, 271 is contacted with the upper surface 242 of the first member 42, subsequently the two legs 206 are fitted in the recesses 240 formed in the first member 42, and then the positioning surface 209 is contacted with the

recess-defining surface 244. In addition, the two bolts 246 are screwed into the first member 42, so that the each sixth member 269, 271 is attached or fixed to the first member 42. In the state in which the each sixth member 269, 271 is fixed to the first member 42, the respective positions of the support rail 198 and the support surface 202 of the each sixth member 269, 271 relative to the first member 42 are the same as those of the rail 198 and the surface 202 of the sixth member 52 relative to the first member 42. Thus, each of the three sixth members 52, 269, 271 guides an EC tape while the feed holes 74 of the carrier tape 64 of the EC tape take a same position relative to the first member 42 in the widthwise direction of the same 42. Accordingly, the EC-tape feeding device 90 which includes a sprocket 272 having projections 274, as described later, can feed the EC tape guided by the each sixth member 52, 269, 271, because the projections 274 of the sprocket 272 can surely engage the feed holes 74 of the carrier tape 64 of the EC tape. Thus, the EC-tape feeding device 90 can feed different sorts of EC tapes having different widths.

**[0082]** In contrast, Figs. 34B and 34C show that the respective portions of the two other sixth members 269, 271 that define the respective support rails 200 and the respective support surfaces 204, project from the first member 42, such that the wider the grooves 190 are the greater the amounts of projection of those portions are. The first member 42 has a width equal to the smallest one of the respective widths of the different sorts of sixth members which are adapted to be used with the first member 42, that is, adapted to be attached to, and detached from, the same 42, for example, the smallest one of the respective widths of the three sixth members 52, 269, 271, that is, the width of the sixth member 52. Thus, the wider (or narrower) EC tapes are guided by the wider (or narrower) sixth members, and are supplied by the wider (or narrower) EC-supply units 32.

**[0083]** Thus, an appropriate one of the three sixth members 52, 269, 271 is selected and attached to the first member 42, depending upon the width of an EC tape to be guided. In the case where EC tapes each having a small width are fed by EC-supply units 32 each having a corresponding small width, those EC-supply units 32 can be attached to each table 30 at the smallest pitch equal to the distance between each pair of adjacent positioning grooves 56. On the other hand, in the case where EC tapes each having a great width are fed by EC-supply units 32 each having a corresponding great width, those EC-supply units 32 cannot be attached to each table 30 at the smallest pitch. In the latter case, the EC-supply units 32 are attached to the table 30 at a pitch equal to the product of the smallest pitch and an integral number not less than two. If the first members 42 would have a great width equal to that of the sixth members 271 for guiding the EC tapes each having the greatest width, those first members 42 would have to be attached to the table 30 at a correspondingly

great pitch, even if those first members 42 may be used to guide EC tapes each having a smaller width. Accordingly, only a smaller number of EC-supply units 32 can be attached to each table 30. In contrast, in the present embodiment, the EC-supply units 32 can be attached to the table 30 at the smallest pitch, when those units 32 feed the EC tapes having the smallest widths. Although not shown in Figs. 34B and 34C, the two other sixth members 269, 271 are provided with respective cover members which are similar to the cover member 210 provided for the sixth member 52 but have respective widths different from that of the same 210. Each of the sixth members 269, 271 is attached to, and detached from, the first member 42, in the state in which the each sixth member 269, 271 is put together with the corresponding cover member. In addition, the position of each cover member in a direction parallel to the EC-feed direction can be changed by a stepwise position changing device (not shown).

**[0084]** The first member 42 can be used with different sorts of third, fourth, and fifth members 46, 48, 50, different sorts of TCT treating devices 92, different sorts of guide rollers 140, and different sorts of detecting heads 152 of the metal detecting device 150. Those different sorts of elements 46, 48, 50, 92, 140, 152 correspond to different sorts of EC tapes having different widths, respectively. Appropriate ones of the different sorts of elements 46, 48, 50, 92, 140, 152 are selected and attached to the first member 42, depending upon the width of EC tapes to be supplied. On the other hand, the EC-tape feeding device 90 and the first and second members 42, 44 are commonly used with the different sorts of sixth members 52, 269, 271. However, one or more of the third to fifth members 46, 48, 50 may be so modified as to be commonly used with the different sorts of sixth members 52, 269, 271, when different sorts of EC tapes having different widths are guided by the same 52, 269, 271, respectively.

**[0085]** Next, there will be described the EC-tape feeding device 90.

**[0086]** As shown in Figs. 19 and 22, the first member 42 supports an axis member 270 such that the axis member 270 is rotatable about an axis line perpendicular to the EC-feed direction, i.e., parallel to the widthwise direction of the each EC-supply unit 32 and the widthwise direction of the EC tape 62. A sprocket 272 as a feed member is attached to the axis member 270 such that the sprocket 272 is not rotatable relative to the axis member 270. The sprocket 272 has a number of projections 274 which project radially outward from an entire outer circumferential surface of the sprocket 272. The projections 274 are engaged with the feed holes of 74 of the carrier tape 64. The sprocket 272 supports a ratchet wheel 276 whose diameter is smaller than that of the sprocket 272, such that the ratchet wheel 276 is concentric with the sprocket 272 and is not rotatable relative to the same 272. As shown in Fig. 24, the sixth member 52 has a recess 278 which prevents the sixth

member 52 from interfering with the sprocket 272 and the ratchet wheel 276. As shown in Fig. 20, the cover member 210 has a recess 279 in a portion thereof corresponding to the feed holes 74 of the carrier tape 64, and the recess 279 prevents the cover member 210 from interfering with the projections 274 of the sprocket 272.

**[0087]** As shown in Figs. 20 and 22, the axis member 270 additionally supports two pivotable members 280, 282 as two reciprocative members, such that each of the two pivotable members 280, 282 is reciprocatively pivotable relative to the axis member 270 about a common axis line. The ratchet wheel 276 has an annular shape, and is fixed with a plurality of pins 283 to the sprocket 272 such that the ratchet wheel 276 is concentrically positioned relative to the sprocket 272. As shown in Fig. 22, the second pivotable member 282 includes a base portion which is located on the same plane as that on which the ratchet wheel 276 is located, and is bent at a lengthwise intermediate portion thereof from which an end portion thereof extends radially outward on the same plane as that on which the first pivotable member 280 is located. The two pivotable members 280, 282 have the same radial length from the common axis line thereof to the respective radially outer ends thereof. The ratchet wheel 276 may be formed as an integral portion of the sprocket 272.

**[0088]** The two pivotable members 280, 282 support respective ratchet pawls 284, 286 at the same radial distance from the common axis line, such that the two ratchet pawls 284, 286 are pivotable about respective pins 288, 290, are engageable with teeth 292 provided on an entire outer circumferential surface of the ratchet wheel 276, and are biased toward respective directions in which the pawls 284, 286 engage the teeth 292, by respective spring members 294, 296 which are provided between the pawls 284, 286 and the corresponding pivotable members 280, 282. When each of the pivotable members 280, 282 is pivoted in a first direction (i.e., a counterclockwise direction in Fig. 19; hereinafter, referred as "the forward direction"), a corresponding one of the ratchet pawls 284, 286 remains engaged with the teeth 292; and when the each pivotable member 280, 282 is pivoted in a second direction (i.e., a clockwise direction in Fig. 19; hereinafter, referred as "the backward direction"), the corresponding one ratchet pawl 286, 284 is moved back over the teeth 292.

**[0089]** Therefore, when each of the pivotable members 280, 282 is pivoted in the forward direction, the ratchet wheel 276 is rotated in its forward direction and the sprocket 272 is rotated to feed forward the EC tape 62. This is an EC-tape feeding action of the EC-tape feeding device 90. However, when the each pivotable member 280, 282 is pivoted in the backward direction, the corresponding one ratchet pawl 284, 286 is moved over the teeth 292 of the ratchet wheel 276. This is a preparing action of the EC-tape feeding device 90 for its next EC-tape feeding action. Thus, each of the two piv-

otable members 280, 282 performs its forward and backward pivotal motions to feed forward the EC tape 62.

[0090] A stepper motor 300 as a rotary drive source as an element of a drive device, and a motion converting device 302 cooperate with each other to pivot reciprocally the two pivotable members 280, 282 in opposite directions, respectively, that is, in such a way that when one of the two members 280, 282 is pivoted in the forward direction, the other member 282, 280 is pivoted in the backward direction and, when the one member 280, 282 is pivoted in the backward direction, the other member 282, 280 is pivoted in the forward direction. The stepper motor 300 is supported by the first member 42 such that an axis line about which the rotor of the motor 300 is rotated is parallel to the common axis line of pivotal motion of the two pivotable members 280, 282. The stepper motor 300 is rotated by an amount or angle proportional to the number of drive signals supplied thereto.

[0091] The motion converting device 302 includes a plate cam 306 as a rotary cam as a sort of cam, a bell-crank lever 308 as a cam follower, and two connection links 310, 312 each as a connecting device as a sort of motion transmitting device. An outer circumferential surface of the plate cam 306 provides a cam surface 314. The plate cam 306 is attached to the first member 42 via an axis member 316 such that the cam 306 is rotatable about an axis line parallel to the common axis line of pivotal motion of the two pivotable members 280, 282. When the rotation of the stepper motor 300 is transmitted to the plate cam 306 via gears 318, 320, 322, the cam 306 is rotated. The cam surface 314 of the plate cam 306 has a generally elliptic shape which includes two identical portions having respective identical shapes, as seen in the circumferential direction of the cam 306. More specifically described, the cam surface 314 includes two first portions the distance from the axis member 316 of each of which continuously increases in the circumferential direction of the cam 306, and two second portions the distance from the axis member 316 of each of which continuously decreases in the same direction. The two first portions are distant from each other by 180 degrees about the axis member 316, the two second portions are distant from each other by 180 degrees about the same 316, and the two first portions and the two second portions are alternate with each other about the same 316. Thus, the four portions in total are distant from one another by a regular angular interval of 90 degrees about the axis member 316.

[0092] Each of the above-indicated four portions of the cam surface 314 is so formed that the bell-crank lever 308 as the cam follower is pivoted according to a known modified constant velocity curve. Therefore, while the bell-crank lever 308 follows each of the above-indicated first portions of the cam surface 314 over 90 degrees, the lever 308 is first pivoted positive-acceleratedly, subsequently at a constant velocity, and then negative-acceleratedly (i.e., deceleratedly); and while

the lever 308 follows each of the second portions of the cam surface 314 over 90 degrees, the lever 308 is pivoted, at respective angles or timings, strictly symmetrically with the pivotal motion thereof along the each first portion, therefore, is pivoted at respective acceleration values whose respective absolute values are equal to those of respective acceleration values at corresponding timings when the lever 308 follows the each first portion but whose positive or negative signs are opposite to those of the latter acceleration values. Thus, the cam surface 34 has a shape which assures that while the plate cam 306 is rotated at a constant velocity, the velocity of pivotal motion of the bell-crank lever 308 is smoothly increased from zero, is kept at a constant velocity for a while, and then is smoothly decreased to zero, and additionally is smoothly decreased from zero, is kept at a constant velocity for a while, and then is smoothly increased to zero.

[0093] The bell-crank lever 308 is attached to the first member 42 via an axis member 324 such that the lever 308 is pivotable about an axis line parallel to the common axis line of pivotal motion of the two pivotable members 280, 282. The lever 308 includes two arms 326, 328 which support respective rollers 330, 332 which are engaged with two portions of the cam surface 314 that are angularly distant from each other by about 90 degrees. Therefore, as the plate cam 306 is continuously rotated in a certain direction, the bell-crank lever 308 is forcedly pivoted in its forward and backward directions, in an alternate manner, so that the two arms 326, 328 of the lever 308 are reciprocally pivoted in a same direction by a same angle irrespective of which direction the lever 308 may be pivoted in. The forward and backward directions of pivotal motion of the lever 308 correspond to a clockwise and a counterclockwise direction in Fig. 19, respectively.

[0094] The two arms 326, 328 have a same length, and respective one circular end portions 334 of the two connection links 310, 312 are pivotally connected to respective end portions of the two arms 326, 328 that are at a same distance from the axis member 324. The respective other circular end portions 334 of the two connection links 310, 312 are pivotally connected to respective end portions of the two pivotable members 280, 282 that are at a same distance from the axis member 270. Each of the respective end portions of the two pivotable members 280, 282 and the two arms 326, 328 to which the circular end portions 334 of the two links 310, 312 are connected, has a recess 336 including a circular portion and a tapered portion. Thus, the respective circular end portions 334 of the links 310, 312 are pivotally connected to the respective circular portions of the respective recesses 336 of the pivotable members 280, 282 and the arms 326, 328, on a common plane. In other words, the arms 326, 328, the links 310, 312, and the pivotable members 280, 282 are pivotally connected to one another on the common plane. The first member 42 supports a plurality of hold-down members 338 which

prevent the connection links 310, 312 from coming off the arms 326, 328 and the pivotable members 280, 282, respectively.

[0095] When the bell-crank lever 308 is pivoted reciprocally, forward and backward, by the plate cam 306, the two pivotable members 280, 282 are pivoted reciprocally, forward and backward, via the respective connection links 310, 312. However, the two connection links 310, 312 connect the two pivotable members 280, 282 to the two arms 326, 328, respectively, such that the two members 280, 282 are pivoted by a same angle but in opposite directions, respectively, that is, such that when one of the two members 280, 282 is pivoted forward, the other member 282, 280 is pivoted backward and, when the one member 280, 282 is pivoted backward, the other member 282, 280 is pivoted forward. The two connection links 310, 312 are connected to the two pivotable members 280, 282 and the two arms 326, 328, such that when the two members 280, 282 are positioned at respective middle angles of respective angular ranges within which the two members 280, 282 are allowed to pivot, the two links 310, 312 extend perpendicular to the corresponding members 280, 282 and such that when the two arms 326, 328 are positioned at respective middle angles of respective angular ranges within which the two arms 326, 328 are allowed to pivot, the two links 310, 312 extend perpendicular to the corresponding arms 326, 328. The two arms 326, 328 have a same length, i.e., a same distance between the axis member 324 and each of the respective portions of the two arms 326, 328 to which the two links 310, 312 are connected. The two pivotable members 280, 282 have a same length, i.e., a same distance between the axis member 270 and each of the respective portions of the two members 280, 282 to which the two links 310, 312 are connected. Therefore, the two arms 326, 328 are always pivoted by a same angle in a same direction, whereas the two pivotable members 280, 282 are always pivoted by a same angle but in opposite directions, respectively.

[0096] When the bell-crank lever 308 is pivoted in its forward direction by the rotation of the plate cam 306, the second pivotable member 282 is pivoted forward so that the sprocket 272 is rotated and the EC tape 62 is fed forward. This is one EC-tape feeding action of the pivotable member 282. During this, the first pivotable member 280 is pivoted backward so that the first ratchet pawl 284 is moved back over the teeth 292 of the ratchet wheel 276, and thus prepares for the next EC-tape feeding action thereof. When the lever 308 is pivoted in its backward direction, the second pivotable member 282 is pivoted backward so that the second ratchet pawl 286 is moved back over the teeth 292 of the ratchet wheel 276, and thus prepares for the next EC-tape feeding action thereof, and the first pivotable member 280 is pivoted forward so that the sprocket 272 is rotated forward, and thus performs one EC-tape feeding action. When one of the two pivotable members 280, 282 is pivoted

backward and a corresponding of the two ratchet pawls 284, 286 is moved over the teeth 292, the ratchet wheel 276 is not rotated backward, because the other member 282, 280 is pivoted forward to rotate the ratchet wheel 272 forward. The ratchet wheel 276 cooperates with each of the two ratchet pawls 284, 286 to provide a one-way pivotal-motion transmitting device which transmits the forward pivotal motion of a corresponding one of the two pivotable members 280, 282 to the sprocket 272 but does not transmit the backward pivotal motion of the corresponding one pivotable member 280, 282 to the same 272. Thus, the two one-way pivotal-motion transmitting devices commonly include the ratchet wheel 272.

[0097] As described above, the cam surface 314 of the plate cam 306 has a generally elliptic shape including two identical portions having an identical shape. As indicated at solid line in Fig. 26, the first pivotable member 280 performs two EC-tape feeding actions and two EC-tape-feed preparing actions, while the plate cam 306 is rotated one time, i.e., over 360 degrees. The second pivotable member 282 does so but, as indicated at two-dot chain line, has an angular-phase difference of 90 degrees from the first member 280. Each time the plate cam 306 is rotated by 90 degrees, the bell-crank lever 308 changes its pivoting direction, and the two pivotable members 280, 282 exchange their pivoting directions with each other and alternately perform their EC-tape feeding actions. As described above, the cam surface 314 is so formed that the bell-crank lever 308 is pivoted according to a modified constant velocity curve. As shown in Fig. 26, the acceleration (and deceleration), A, of each of the two pivotable members 280, 282 is smoothly changed, that is, the each pivotable member 280, 282 is smoothly accelerated from the velocity, V, of zero and smoothly decelerated to the velocity V of zero, and additionally is smoothly decelerated from the velocity V of zero and smoothly accelerated to the velocity V of zero.

[0098] Therefore, the inertia produced when the sprocket 272 and the ratchet wheel 276 are stopped is small. In addition, the biasing force of each of the spring members 294, 296 to bias a corresponding one of the ratchet pawls 284, 286 in a direction to engage the teeth 292 of the ratchet wheel 272 is predetermined at a value which can prevent the corresponding one ratchet pawl 284, 286 from being pivoted by the sprocket 272 and the wheel 276 against the biasing force of the each spring member 294, 296. Thus, the sprocket 272 and the ratchet wheel 276 are prevented from being rotated in excess of an angular position which is given thereto by the forward pivotal motion of each of the pivotable members 280, 282. Accordingly, each of the ECs 60 held by the EC tape 62 is accurately positioned at the EC-supply position of the each EC-supply unit 32.

[0099] A pitch at which the EC tape 62 is fed when each of the two pivotable members 280, 282 performs one EC-tape feeding action, will be referred to as "the reference pitch". The reference pitch is equal to the

smallest one of respective different pitches at which ECs are held by different sorts of EC tapes. As described previously, in the case where different sorts of ECs having different dimensions are held at different pitches by different sorts of EC tapes, the different pitches are the reference pitch or the product of the reference pitch and an integral number M not less than two. Therefore, when the first EC tape 62 holding the ECs 60 at the smallest pitch, i.e., the reference pitch is fed over a distance equal to the reference pitch, the plate cam 306 needs to be rotated by 90 degrees to drive the sprocket 272 one time; and when the second EC tape 75 holding the ECs 60 at a pitch equal to twice the reference pitch is fed over a distance equal to twice the reference pitch, the cam 306 needs to be rotated by 180 degrees to drive the sprocket 272 two times. The first EC tape 62 provides a first sort of EC tape, and the second EC tape 75 provides a second sort of EC tape. Similarly, when an EC tape holding ECs at a pitch equal to the product of the reference pitch and the integral number M (not less than three) is fed over a distance equal to that product, the cam 306 needs to be rotated by  $(90 \times M)$  degrees to drive the sprocket 272, M times.

**[0100]** Respective gear ratios of the gears 318, 320, 322 which transmit the rotation of the stepper motor 300 to the plate cam 306 are predetermined such that when the motor 300 is fully rotated one time, the cam 306 is rotated by 90 degrees and the sprocket 272 is driven one time. Therefore, when the sprocket 272 needs to be driven one time, the motor 300 is fully rotated one time; and when the sprocket 272 needs to be driven M times (not less than two), the motor 300 is rotated M times. Thus, the motor 300 can be easily controlled.

**[0101]** The first member 42 supports a rotation-stop-position detecting device 350 which detects that the plate cam 306 is positioned at any one of its four rotation stop positions which are equiangularly distant from one another by 90 degrees. The detecting device 350 includes a detection plate 352 fixed to the axis member 316 to which the plate cam 306 is fixed, and a rotation-stop-position sensor 354. The detection plate 352 has four dogs 356 which are equiangularly distant from one another about the axis member 316. The rotation-stop-position sensor 354 is provided by a transmission-type optical sensor which includes a light emitter and a light receiver. When the plate cam 306 is positioned at any one of the four rotation-stop positions, a corresponding one of the four dogs 356 interrupts the light emitted by the light emitter and prevents the light receiver from receiving the light.

**[0102]** Irrespective of whether the sprocket 272 needs to be driven one time or M times, the rotation-stop-position sensor 354 produces a stop-position signal, so long as the stepper motor 300 does not go out of synchronism and accordingly accurately stops the plate cam 306 at one of its rotation-stop positions. However, if the motor 300 goes out of synchronism and accordingly does not stop the cam 306 at any rotation-stop po-

sitions, the light receiver receives the light emitted by the light emitter and accordingly the sensor 354 does not produce the stop-position signal. Thus, the unit controller 500 recognizes that the stepper motor 300 is out of synchronism, and operates for eliminating the difference between the number of drive signals supplied to the motor 300 and the current rotation position of the same 300. More specifically described, if the stop-position signal is produced when the motor 300 is additionally rotated by a predetermined small angle, the motor 300 is further rotated so that one of the dogs 356 is aligned with the respective centers of the light emitter and receiver as seen in the direction of rotation of the detection plate 352. On the other hand, if the stop-position signal is not produced, the unit controller 500 immediately informs the operator of the occurrence of an abnormality, for example, operates an alarm device 532 (Fig. 31) to produce an alarm sound in a manner described later. Alternatively, the controller 500 may do so after having tried a predetermined number of times to rotate additionally the motor 300 and thereby obtain the stop-position signal.

**[0103]** Next, the TCT treating device 92 will be described in detail.

**[0104]** As shown in Fig. 27, the TCT treating device 92 includes a TCT feeding device 366 and a TCT collecting box 368. As shown in Fig. 15, the fifth member 50 fixed to the first member 42 has a shape like a plate, is thinner than the same 42, and projects upward from the same 42. The first member 42 provides a main frame member, the fifth member 50 provides a secondary frame member, and the first and fifth members 42, 50 provides respective elements of a frame 369 of the TCT feeding device 366.

**[0105]** As shown in Fig. 27, a roller 382 is attached to a side surface of the fifth member 50 such that the roller 382 is rotatable about an axis line parallel to the widthwise direction of the top cover tape ("TCT") 66. The TCT 66 which is peeled from the carrier tape 64 is folded back about 180 degrees at an end of the opening 212 of the cover member 210, and is engaged with the roller 382 such that the widthwise direction of the TCT 66 is substantially horizontal and is parallel to the widthwise direction of the each EC-supply unit 32. The opening 212 of the cover member 210 and the roller 382 cooperate to define a path along which the TCT 66 is fed. The roller 382 has a pair of flanges (not shown) which prevent the TCT 66 from moving out of position in its widthwise direction.

**[0106]** The fifth member 50 supports a tension adjusting device 371 which is provided on an upstream side of the roller 382 as seen in the direction in which the TCT 66 is fed (hereinafter, referred to as "the TCT-feed direction"), that is, is provided such that the tension adjusting device 371 is nearer to the opening 212 of the cover member 210 than the roller 382. The tension adjusting device 371 includes a roller-support lever 370 as a roller-support member, a roller 372 supported by the

lever 370, and a spring member 374 as an elastic member as a sort of biasing device. The roller-support lever 370 is attached, at one end portion thereof, to the fifth member 50 such that the lever 370 is pivotable about an axis line parallel to the widthwise direction of the TCT 66.

[0107] The roller 372 is rotatably attached to the other end portion of the roller-support lever 370. The lever 370 has a length which can cross the path of feeding of the TCT 66, and supports the roller 372 such that the roller 372 is movable in a direction in which the roller 372 crosses the path. The spring member 374 whose one end is engaged with the fifth member 50 biases the roller-support lever 370 in a direction in which the roller 372 engages and bends the TCT 66 and thereby changes the path of feeding of the same 66. The roller 372 has a pair of flanges (not shown) which prevent the TCT 66 from moving out of position in its widthwise direction.

[0108] The roller-support lever 370 includes a detection member 376 as a detectable portion that projects in a direction (i.e., clockwise in Fig. 27) opposite to the direction in which the spring member 374 biases the lever 370. The fifth member 50 supports a roller-position sensor 378 at a downstream-side end of locus of movement of the detection member 376 as seen in the direction of projection of the same 376. The roller-position sensor 378 is provided by a transmission-type optical sensor which includes a light emitter and a light receiver and, when the roller-support lever 370 is pivoted or moved against the biasing force of the spring member 374 so that the detection member 376 interrupts the light emitted by the light emitter and prevents the light receiver from receiving the light, the sensor 378 detects that the lever 370 or the roller 372 has reached a predetermined position. The roller-position sensor 378 and the detection member 376 cooperate with each other to provide a roller-position detecting device 379.

[0109] The limit of pivotal motion of the roller-support lever 370 due to the biasing action of the spring member 374 is defined by a stopper member 380 supported by the fifth member 50, and the limit of pivotal motion of the lever 370 in the direction toward the roller-position sensor 378 is defined by a stopper member 381 supported by the fifth member 50. The second stopper 381 is provided at a position which assures that the stopper 381 stops the lever 370 after the detection member 376 interrupts the light emitted by the light emitter of the roller-position sensor 378, and before the member 376 interferes with the sensor 378.

[0110] The TCT 66 which is engaged with the roller 372 is additionally engaged with the roller 382, and is further pinched by a pair of feed gears 384, 386 as TCT-feed rotatable members. The tension adjusting device 371 is provided on an upstream-side of the feed gears 384, 386 in the direction of feeding of the TCT 66. The axis line of rotation of the roller 382 is level with respective meshing portions of the feed gears 384, 386. Thus, the TCT 66 which leaves the roller 382 easily enters and

leaves the feed gears 384, 386 in a direction perpendicular to a straight line connecting between respective axis lines of rotation of the feed gears 384, 386.

[0111] The two feed gears 384, 386 have a same size and are provided by respective moldings each formed of aluminum. As shown in Fig. 28, end portions of each tooth 388 of each feed gear 384, 386 are rounded to provide rounded portions 390. The first feed gear 384 is rotated by a rotary drive device 394. As shown in Fig. 28, an axis member 396 is supported by the fifth member 50 such that the axis member 396 extends parallel to the widthwise direction of the TCT 66, i.e., a direction perpendicular to the direction of feeding of the TCT 66, and the feed gear 384 is rotatably attached to the axis member 396. A worm wheel 398 is provided as an integral portion of the first feed gear 384. The worm wheel 398 is meshed with a worm 402 which is supported by a support block 400 fixed to the fifth member 50, such that the worm 402 is rotatable about an axis line perpendicular to the widthwise direction of the TCT 66. When the worm 402 is rotated by a DC (direct current) motor 408 as a sort of electric motor as a drive source, via gears 404, 406 (Fig. 27), the feed gear 384 is rotated.

[0112] The DC motor 408 is attached to a bracket 410 fixed to the fifth member 50, such that an axis line of rotation of a rotor of the motor 408 is parallel to the axis line of rotation of the worm 402, that is, is perpendicular to the widthwise direction of the TCT 66. The worm 402 and the worm wheel 398 cooperate with each other to transmit or transform the rotation of the rotor of the DC motor 408 about the axis line perpendicular to the widthwise direction of the TCT 66, into the rotation of the feed gear 384 about the axis line parallel to the widthwise direction of the TCT 66. Therefore, the each EC-supply unit 32 can have a smaller widthwise dimension as compared with the case where the DC motor 408 would be provided such that the axis line of rotation of its rotor is parallel to the widthwise direction of the TCT 66. The worm wheel 398, the worm 402, and the gears 404, 406 cooperate with one another to provide a rotation transmitting device 312, which cooperates with the DC motor 408 to provide the rotary drive device 394.

[0113] The second feed gear 386 is rotatably supported by a gear-support lever 420 as a rotatable-member-support lever as a sort of rotatable-member-support member that is pivotally attached to the fifth member 50 at a level higher than the first feed gear 384. A spring member 422 as an elastic member as a sort of biasing device that is provided between the lever 420 and the fifth member 50 biases the lever 420 in a direction toward the first feed gear 384. Thus, the second feed gear 386 can be moved toward, and away from, the first feed gear 384. The straight line connecting between the respective axis lines of rotation of the two feed gears 384, 386 is vertical, and the two feed gears 384, 386 are meshed with each other on the vertical straight line.

[0114] The gear-support lever 420 includes an operable portion 424 which extends in a direction parallel to



the widthwise direction of the TCT 66. The operator pivots, with his or her fingers, the operable portion 424 of the lever 420 against the biasing force of the spring member 422, and thereby moves the second feed gear 386 away from the first feed gear 384. In this state, the operator can insert an end portion of the TCT 66 in between the two feed gears 384, 386. When the operator releases his or her fingers from the operable portion 424, the second feed gear 386 is biased and moved toward the first feed gear 384, so that the end portion of the TCT 66 is pinched between the respective teeth 388 of the two feed gears 384, 386.

[0115] As shown in Figs. 28 and 29, the two feed gears 384, 386 have, at respective axially middle portions thereof, respective annular scraper grooves 430, 432 which are formed in respective outer circumferential surfaces thereof. Two scrapers 434, 436 are partly fitted in the two scraper grooves 430, 432, respectively. The scrapers 434, 436 are provided by respective metallic thin plates.

[0116] The first scraper 434 provided for the first feed gear 384 includes a lengthwise middle narrowed portion whose width assures that the middle narrowed portion can be fitted in the first scraper groove 430; two lengthwise intermediate widened portions which are located on both sides of the middle narrowed portion and whose width is equal to that of the first feed gear 384; and lengthwise opposite end portions whose width is greater than that of the gear 384, as shown in Fig. 29, and is somewhat smaller than the distance between the fifth member 50 and a cover member 438 which is fixed to the support block 400 to cover the feed gears 384, 386. The cover member 438 is provided adjacent to the feed gears 384, 386 in a direction parallel to the respective axis lines of rotation of the gears 384, 386, such that the cover member 438 covers a side surface of the fifth member 50 from an upstream portion of the side surface with respect to the respective meshing portions of the gears 384, 386 as seen in the direction of feeding of the TCT 66, via a portion of the surface corresponding to those meshing portions, to a downstream portion of the surface adjacent to the TCT collecting box 368. The cover member 438 cooperates with the first and fifth members 42, 50 to provide the frame 369 of the TCT feeding device 366.

[0117] The narrowed middle portion of the first scraper 434 is fitted in the first scraper groove 430, the two widened portions of the same 434 on both sides of the middle portion that are not fitted in the groove 430 are bent along the first feed gear 384, and the two end portions of the same 434 are fixed to the support block 400. That is, a portion of the first scraper 434 is fitted in the first scraper groove 430, such that that portion of the scraper 434 is present in the respective meshing portions of the two feed gears 384, 386. Thus, the first scraper 434 is continuously present from a position upstream of the first feed gear 384 to a position downstream of the same 384 as seen in the direction of feed-

ing of the TCT 66. Since the first scraper groove 430 is deeper than respective tooth grooves of the teeth 388 of the first feed gear 384, the portion of the first scraper 434 that is present in the meshing portions of the feed gears 384, 386 does not interfere with the feeding of the TCT 66. In addition, the first scraper 434 starts guiding the TCT 66 just when the TCT 66 leaves the meshing portions of the feed gears 384, 386. All the above explanations are true with the second scraper groove 432, the second scraper 436, and the second feed gear 386.

[0118] As shown in Fig. 29, the first scraper 434 has an opening 440 which is for preventing the scraper 434 from interfering with the worm 402. The first scraper 434, except for its middle portion fitted in the first scraper groove 430, is provided in close contact with the cover member 438, which contributes to preventing the TCT 66 from entering a space possibly left between the cover member 438 and the first feed gear 384.

[0119] Like the first scraper 434, the second scraper 436 provided for the second feed gear 386 includes a lengthwise middle narrowed portion whose width assures that the middle narrowed portion can be fitted in the second scraper groove 432; and two widened portions which are located on both sides of the middle narrowed portion and whose width is equal to that of the second feed gear 386. The narrowed middle portion of the second scraper 436 is fitted in the second scraper groove 432 of the second feed gear 386, the two widened portions of the same 436 on both sides of the middle portion that are not fitted in the groove 432 are bent along the second feed gear 386, and opposite end portions of the same 436 are fixed to the gear-support lever 420. That is, a portion of the second scraper 436 is fitted in the second scraper groove 432, such that that portion of the scraper 436 is present in the respective meshing portions of the two feed gears 384, 386. Thus, the second scraper 436 is continuously present from a position upstream of the second feed gear 386 to a position downstream of the same 386 in the direction of feeding of the TCT 66. The second scraper 436, except for its middle portion fitted in the second scraper groove 432, is provided in close contact with the cover member 438, which contributes to preventing the TCT 66 from entering a space possibly left between the cover member 438 and the second feed gear 386. A material having a low friction coefficient, such as polytetrafluoroethylene, is applied to respective surfaces of the scrapers 434, 436 that are exposed to the path of feeding of the TCT 66, to lower respective friction coefficients of those surfaces of the same 434, 436.

[0120] Thus, the two scrapers 434, 436 are provided for the two feed gears 384, 386, respectively, such that the scrapers 434, 436 are continuously present from the upstream side of the gears 384, 386 to the downstream side of the same 384, 386, that is, the respective one widened portions of the scrapers 434, 436 are present on the side of an inlet of the meshed gears 384, 386, that is, on an upstream side of the same 384, 386 in the



direction of feeding of the TCT 66, and the respective other widened portions of the scrapers 434, 436 are present on the side of an outlet of the gears 384, 386, that is, on a downstream side of the same 384, 386 in the same direction. An angle contained by the respective widened portions of the two scrapers 434, 436 at each of the inlet and the outlet of the meshed gears 384, 386 is greater than 45 degrees, most preferably, greater than 120 degrees.

[0121] The TCT 66 fed by the feed gears 384, 386 is collected by the TCT collecting box 368. The collecting box 368 is provided on a downstream side of the feed gears 384, 386 in the direction of feeding of the TCT 66, and is detachably attached to the fifth member 50. As shown in Fig. 30, an upper end portion of a rear portion of the fifth member 50 is first bent toward a widthwise middle portion of the each EC-supply unit 32 and then bent vertically upward to provide a positioning portion 452 which extends in the lengthwise direction of the unit 32.

[0122] As shown in Figs. 27 and 30, the TCT collecting box 368 includes two beam members 454, 456 each of which has a shape like a thick block, and two thin side plates 458, 460 which are fixed to respective side surfaces of the beam members 454, 456, and has a front and a rear opening as seen in a direction parallel to the direction of feeding of the TCT 66. The beam members 454, 456 and the side plates 458, 460 are formed of a metallic material, such as aluminum, which contributes to preventing the TCT 66 from adhering to the collecting box 368.

[0123] As shown in Fig. 30, the rear opening of the TCT collecting box 368 that is more distant from the feed gears 384, 386 than the front opening thereof is closed by a lid 464 which is formed of a magnetic material and which is pivotally attached to the first beam member 454 via an axis member 462. The lid 464 is kept closed because the lid 464 is attracted by a magnet 466 fixed to the second beam member 456. Since the lid 464 has a window 468, the operator can look into an inside space of the box 368 through the window 468. Since the window 468 is covered by a transparent resin sheet 470, the TCT 66 does not "leak" from the box 368.

[0124] The front opening of the TCT collecting box 368 that is near to the feed gears 384, 386 is kept open, and provides an inlet 472 through which the TCT 66 flows into the box 368. As shown in Fig. 27, the first beam member 454 includes a TCT-guide projection 474 which projects obliquely upward and frontward, toward the first scraper 434, and which guides the flowing of the TCT 66 into the box 368. Polytetrafluoroethylene is applied to respective inner surfaces of the beam members 454, 456, the side plates 458, 460, the lid 464, and the guide projection 474 that are exposed to the inside space of the box 368, to lower respective friction coefficients of those inner surfaces and thereby prevent the TCT 66 from adhering thereto.

[0125] As shown in Fig. 30, the first beam member

454 has a positioning groove 476 formed in a widthwise middle portion thereof. The operator fits the positioning groove 476 on the positioning portion 452 of the fifth member 50, thereby positioning the TCT collecting box 368 in the widthwise direction thereof, and then moves the box 368 forward on the positioning portion 452. Thus, the box 368 is attached to the fifth member 50. Similarly, the second beam member 456 has a positioning groove 478 formed in a widthwise middle portion thereof, and the operator fits the positioning groove 478 on another positioning portion 480 of the fifth member 50, thereby positioning the box 368 in the widthwise direction thereof.

[0126] Two ball plungers 482 are provided on both side surfaces of the positioning portion 480 of the fifth member 50 (only one plunger 482 is shown in Fig. 27; the fifth member 50 is indicated at two-dot chain line but the one ball plunger 482 is indicated at solid line and broken line for easier understanding purposes only). Each of the two ball plungers 482 includes a casing 484 having a threaded outer circumferential surface; a ball 486 as an engaging member that is accommodated in the casing 484; and a spring member 486 as an elastic member as a sort of biasing device that biases the ball 486 in a direction in which the ball 486 projects out of the casing 484. The TCT collecting box 368 is moved to a position where the respective balls 484 of the two ball plungers 482 project and engage respective conical holes 490 as engaging holes which are formed in the second beam member 456, so that the box 368 is positioned in the lengthwise direction thereof. Since the box 368 is thus engaged with the fifth member 50, the box 368 is prevented from moving out of position due to, e.g., vibration exerted thereto. In this state, the TCT-guide projection 474 projects toward the first scraper 434 provided for the first feed gear 384, to a position adjacent to the scraper 434, and guides the TCT 66 from the scraper 434 to the box 368. The operator can remove the box 368 from the fifth member 50, by drawing the box 368 in a direction away from the fifth member 50, thereby causing the balls 486 to be pushed back into the casings 484 against the biasing forces of the spring members 488, and moving the box 368 rearward. As shown in Fig. 27, the gear-support lever 420 includes a closing portion 492 which extends parallel to the widthwise direction of the TCT 66 and which prevents the TCT 66 from "leaking" out of the inlet 472 of the box 368.

[0127] As shown in Fig. 27, a fixed handle member 550 is detachably attached to an upper end portion of the fifth member 50, such that the fixed handle member 550 is positioned in the widthwise direction of the each EC-supply unit 32. A movable handle member 552 is supported by the fixed handle member 550 such that the movable handle member 552 is movable in a direction parallel to the lengthwise direction of the each unit 32. A rear end portion of the movable handle member 552 projects rearward from the fifth member 50. The operator can draw or move the movable handle member

552 rearward by grasping the projecting end portion of the member 552. The operator attaches and detaches the each unit 32 to and from the table 30, while grasping the movable handle member 552 drawn out of the fifth member 50, and carries the each unit 32 while grasping the fixed handle member 550 with the movable handle member 552 being drawn out.

**[0128]** As shown in Fig. 30, the movable handle member 552 has, in an outer circumferential surface thereof, two flat surfaces 553 as rotation preventing surfaces that extend in a direction parallel to the lengthwise direction of the member 552 and that prevent the member 552 from rotating relative to the fixed handle member 550. In addition, the movable handle member 552 has, in the outer circumferential surface thereof, two chamfered portions that extend in the lengthwise direction of the fixed handle member 550 and that have respective surfaces 554 to one of which a bar-code seal 556 is adhered. A bar code representing identification information identifying the each EC-supply unit 32 from the other EC-supply units 32 is printed on the bar-code seal 556.

**[0129]** As shown in Fig. 1, the carrier tape 64 from which the ECs 60 have been supplied is guided by a guide member 494 provided on the car 34, to a tape cutter 496, so that the carrier tape 64 is cut into small pieces by the tape cutter 496 and the small pieces are collected by a collecting box 498.

**[0130]** As shown in Fig. 31, each of the EC-supply units 32 includes a unit controller 500 including three computers (not shown) which are exclusively used to monitor the connection of two EC tapes 62 on the each unit 32, control the stepper motor 300, and control the DC motor 408, respectively. In addition, the connection detecting circuit 168 of the metal detecting device 150, the rotation-stop-position sensor 354, the roller-position sensor 378, and an operation panel 502 are connected to the unit controller 500. Fig. 32 shows a flow chart representing a connection monitoring routine which is stored in a read only memory ("ROM") of the first exclusive computer which monitors the connection of two EC tapes 62, and a random access memory ("RAM") of the first computer includes, in addition to a working memory, a reference-identification-information memory 504, an input-identification-information memory 506, an identification-information-input-time memory 508, a connection-portion-detect-time memory 510, and a remaining-amount counter 512. A processing unit ("PU") of the first computer includes a timer.

**[0131]** As shown in Fig. 31, the unit controller 500 of each EC-supply unit 32 is connected to a car-side controller 520 which is provided on each car 34, and exchanges information with the car-side controller 520. Each of the two car-side controllers 520 is connected to a mounting-system controller 530 which is employed by the EC mounting system 16, and exchanges information with the mounting-system controller 530. The mounting-system controller 530 controls the alarm device 532 and

a display device 534 which are employed by the EC mounting system 16, such that the alarm device 532 generates an alarm sound and the display device 534 displays information describing an error which has occurred. A bar-code reader 538 is connected to the each car-side controller 520. The mounting-system controller 530 is connected to a host computer 540, and exchanges information with the host computer 540.

**[0132]** In the CB assembling system 10 constructed as described above, the EC sucker 22 is moved to take an EC 60 from one of the EC-supply units 32 and mount the EC 60 on a PWB 20. After the EC sucker 22 takes the EC 60 and before the sucker 22 mounts the EC 60 on the PWB 20, the image taking device 38 takes an image of the EC 60 held by the EC sucker 22, and the mounting-system controller 530 calculates, based on image data representing the taken image, X-direction and Y-direction position errors of the EC 60 held by the EC sucker 22 and a rotation position error of the EC 60 about an axis line of the EC 60. In addition, before the EC 60 is mounted on the PWB 20, another image taking device (not shown) takes respective images of two reference marks which are affixed to two portions of the PWB 20, respectively, that are diagonally distant from each other, and the controller 530 calculates, based on image data representing the taken images, X-direction and Y-direction position errors of each of a plurality of EC-mount places on the PWB 20 where ECs 60 are to be mounted. After the X-direction and Y-direction position errors of the EC 60, the X-direction and Y-direction position errors of the EC-mount place where the EC 60 is to be mounted, and the rotation position error of the EC 60 are corrected, the EC 60 is mounted at the EC-mount place on the PWB 20.

**[0133]** Each of the EC-supply units 32 is waiting for supplying the following EC 60, in the state in which the preceding EC 60 has been taken from the embossed portion 70 of the carrier tape 64, that is, in the state in which the empty embossed portion 70 is positioned at the EC-supply position. The mounting-system controller 530 selects one of the EC-supply units 32 that is next to supply an EC 60 to the EC sucker 22, and sends, to the unit controller 500 of the selected unit 32, a command that commands the exclusive computer of the unit controller 500 to operate the stepper motor 300 and thereby feed the EC tape 62.

**[0134]** The stepper motor 300 is rotated by an amount needed for the following EC 60 to be moved to the EC-supply position, depending upon the pitch at which the ECs 60 are held by the EC tape 62. Since the pitch at which the ECs 60 are held by the first EC tape 62 is the smallest pitch equal to the reference pitch, the stepper motor 300 is controlled to rotate the plate cam 306 by 90 degrees. Consequently one of the two pivotable members 280, 282 performs one EC-tape feeding action (i.e., one forward motion) to feed the EC tape 62 by a distance equal to the reference pitch. That is, one EC-tape feeding action of the pivotable member 280 or 282

causes the sprocket 272 to be driven one time, so that the following EC 60 is moved to the EC-supply position. Each time the sprocket 272 is driven one time, one EC 60 is supplied to the EC sucker 22. Hereinafter, this EC supplying step will be referred to as the single-feeding-action EC supplying step.

[0135] In the case where one EC-supply unit 32 feeds the second EC tape 75 and supplies the ECs 60 from the same 75, the pitch at which the ECs 60 are held by the tape 75 is twice the reference pitch, and the stepper motor 300 is controlled to rotate the plate cam 306 by 180 (i.e.,  $90 \times 2$ ) degrees. Thus, the two pivotable members 280, 282 alternately perform respective EC-tape feeding actions (i.e., respective forward motions), each one time, so that the sprocket 272 is driven two times and the following EC 60 is moved to the EC-supply position. Since one EC 60 is supplied to the EC sucker 22 each time the sprocket 272 is driven M (e.g., two) times, this EC supplying step will be referred to as the M-time-feeding-action EC supplying step. The exclusive computer of the unit controller 500 that controls the stepper motor 300 provides a tape-feed control device which controls the number of rotations of the stepper motor 300, depending upon a pitch at which ECs are held by an EC tape, so that the EC tape is fed by a distance equal to the pitch.

[0136] In the case where one EC is supplied to the EC sucker 22 each time the sprocket 272 is driven one time, the EC sucker 22 is lowered in synchronism with the feeding of an EC tape in response to the single driving of the sprocket 272. Meanwhile, in the case where one EC is supplied to the EC sucker 22 each time the sprocket 272 is driven M times, the EC sucker 22 is moved downward in synchronism with the feeding of an EC tape in response to the last or M-th driving of the sprocket 272. The mounting-system controller 530 functions as a synchronism control device which controls the EC sucker 22 such that the EC sucker 22 is moved downward concurrently with at least a portion of the single or M-th feeding of an EC tape, or immediately after the single or M-th feeding of the EC tape has ended. In the case where the EC sucker 22 is moved downward concurrently with at least a portion of the single or M-th feeding of an EC tape, the single or M-th feeding of the EC tape ends before the EC sucker 22 takes an EC from the EC tape, that is, the leading EC of the EC tape is moved to the EC-supply position before the EC sucker 22 sucks and holds the leading EC. Since the mounting-system controller 530 can obtain, from the unit controller 500 of each EC-supply unit 32, information relating to the feeding of the EC tape, i.e., information relating to the driving of the sprocket 272, the mounting-system controller 530 can control, based on the obtained information, the downward movement of the EC sucker 22.

[0137] As described above, the cam surface 314 of the plate cam 306 is so formed that each of the two pivotable members 280, 282 is pivoted according to the modified constant velocity curve shown in Fig. 26. More

specifically described., the bell-crank lever 308 is smoothly accelerated from the speed of zero, subsequently pivoted at a constant velocity, and then smoothly decelerated to the speed of zero, so that each of the two pivotable members 280, 282 is smoothly accelerated from the speed of zero, subsequently pivoted at a constant velocity, and then smoothly decelerated to the speed of zero. Therefore, the feeding of the EC tape 62 can be started and stopped with reduced vibration, and accordingly each EC 60 can be prevented from jumping out of the embossed portion 70 or changing its posture in the embossed portion 70.

[0138] In addition, since the two pivotable members 280, 282 alternately perform respective EC-tape feeding actions and substantially continuously drive the sprocket 272, the EC tape 62 is fed forward without cease. Therefore, even in the case where the pitch at which ECs are held by an EC tape is M times longer than the reference pitch, the EC tape can be fed quickly.

[0139] The second exclusive computer of the unit controller 500 controls the stepper motor 300 and thereby controls the feeding of the EC tape 62. This exclusive computer, a drive circuit (not shown) for driving the stepper motor 300, and the rotation-stop-position detector 350 cooperate with one another to provide a drive-source control device.

[0140] As described above, if the stepper motor 300 goes out of synchronism, the second computer of the unit controller 500 performs countermeasures including additionally rotating the stepper motor 300 by a small angle, so as to obtain the stop-position signal produced by the rotation-stop-position sensor 354. On the other hand, if the unit controller 500 cannot eliminate the error that has occurred, because of the out-of-synchronism state, between the number of drive signals supplied to the motor 300 and the current rotation position of the same 300, the mounting-system controller 530 controls, based on the commands supplied from the unit controller 500 via the car-side controller 520, the alarm device 532 to produce an alarm sound indicating that an abnormality has occurred, and controls the display device 534 to display a screen image describing what the abnormality is.

[0141] When the EC tape 62 is fed forward, the stepper motor 300 is operated and simultaneously the DC motor 408 of the TCT feeding device 366 is operated. Thus, the TCT 66 is fed forward while being peeled from the carrier tape 64, so that the TCT 66 is collected into the TCT collecting box 368. This means that the TCT feeding device 366 also functions as a TCT peeling device.

[0142] When the DC motor 408 is operated, the two feed gears 384, 386 are rotated to feed the TCT 66. Since the amount of peeling of the TCT 66 from the carrier tape 64 is limited by the end of the opening 212 of the cover member 210, the TCT 66 is peeled from the carrier tape 64 by an amount equal to the amount of feeding of the carrier tape 64 or the EC tape 62. Since

it is required that the TCT 66 be accurately peeled by the amount equal to the amount of feeding of the carrier tape 64, the feed gears 384, 386 are rotated to feed the TCT 66, by an amount more than the amount of feeding of the carrier tape 64.

[0143] The above-indicated excessive rotation of the feed gears 384, 386 is allowed because then the tensile force of the TCT 66 is increased and accordingly the roller-support lever 370 is pivoted against the biasing force of the spring member 374. The DC motor 408 is stopped before the stepper motor 300 is stopped, and accordingly the feed gears 384, 386 are stopped before the feeding of the carrier tape 64 is stopped. As the carrier tape 64 is fed after the stopping of the feed gears 384, 386, the roller-support lever 370 is pivoted by the biasing action of the spring member 374, so that the TCT 66 is peeled from the carrier tape 64. While the carrier tape 64 is fed, the tensile force of the TCT 66 is adjusted by the lever 370, so that the TCT 66 is fed while being peeled, without being loosened.

[0144] More specifically described, the amount of feeding of the TCT 66 is somewhat more than that of the carrier tape 64, and accordingly the roller-support lever 370 is positioned, because of the increased tensile force of the TCT 66, at a position nearer to the roller-position sensor 378 than the stopper member 380. Though the lever 370 is pivoted against the biasing force of the spring member 374, the lever 370 is not contacted with the stopper member 380 and the TCT 66 is not loosened. However, as the feeding of the EC tape 62 is repeated and the peeling and feeding of the TCT 66 is repeated, eventually the detection member 376 of the lever 370 is detected by the roller-position sensor 378, so that the DC motor 408 is stopped. Thus, the tensile force of the TCT 66 is prevented from exceeding a predetermined value, and the TCT 66 is prevented from being broken. As the EC tape 62 is fed after the DC motor 408 is stopped, the lever 370 is pivoted by the spring member 374, so that the TCT 66 is peeled from the carrier tape 64 while being stretched out. If the time period in which the TCT 66 is fed by the operation of the DC motor 408 has not ended yet when the lever 370 is pivoted by the biasing action of the spring member 374 and accordingly the roller-position sensor 378 no longer detects the detection member 376, the DC motor 408 is started again to rotate the feed gears 384, 386 and thereby feed the TCT 66.

[0145] The roller-position sensor 378 can detect an abnormality which occurs to the TCT feeding device 366. For example, if the DC motor 408 continues to operate, for some reason, even after the feeding of the EC tape 62 ends, the tensile force of the TCT 66 is increased and the roller-support lever 370 is pivoted against the biasing force of the spring member 374, so that the detection member 376 is detected by the roller-position sensor 378. Thus, the unit controller 500 can recognize that an abnormality has occurred to the DC motor 408 or a control circuit to control the motor 408,

and can stop the operation of the motor 408. Thus, the TCT 66 is prevented from being broken. In addition, the unit controller 500 commands the mounting-system controller 530 to control the alarm device 532 and the display device 534 to inform the operator of the occurrence of abnormality. The third exclusive computer of the unit controller 500 controls the DC motor 408 based on the detection signals supplied from the roller-position sensor 378. Thus, the exclusive computer of the unit controller 500 that controls the DC motor 408 of the TCT feeding device 366 provides a TCT-feed stopping device.

[0146] The TCT 66 which has been peeled from the carrier tape 64 and fed by the feed gears 384, 386 flows into the TCT collecting box 368 through the inlet 472 thereof. Since the two feed gears 384, 386 are rotated while the respective teeth 388 thereof mesh each other and pinch the TCT 66, the TCT 66 is surely fed forward. In addition, the second scraper 436 provided for the second feed gear 386 can surely peel the TCT 66 from the teeth 38 of the gear 386, even if the TCT 66 may be adhered to the teeth 38 because of a tacky material possibly left on one major surface of the TCT 66 that has been adhered to the carrier tape 64. Thus, the TCT 66 is prevented from remaining adhered to the teeth 388 of the second feed gear 386 and interfering with the feeding of the following portion of the TCT 66. The other major surface of the TCT 66 on which no tacky material is provided is contacted with the first feed gear 384. The first scraper 434 which is provided for the first feed gear 384 peels, even if the TCT 66 may hang down onto the gear 384 because of its own weight, the TCT 66 from the teeth 388 of the gear 384 and thereby prevents the TCT 66 from jamming on the gear 384.

[0147] In addition, the respective bent, widened portions of the two scrapers 434, 436 that are provided on the side of the outlet of the two feed gears 384, 386 open about 120 degrees. Accordingly, the TCT 66 is not adhered to the scrapers 434, 436 and is smoothly fed to the TCT collecting box 368. Since polytetrafluoroethylene is applied to the respective surfaces of the scrapers 434, 436 that face the path of feeding of the TCT 66, and the inner surfaces of the box 368, to lower their respective friction coefficients, the TCT 66 is not adhered to those elements 434, 436, 368.

[0148] The operator can look into the inner space of the TCT collecting box 368 through the window 468 and judge whether the box 368 is full of the collected TCT 66. If a positive judgment is made, the operator opens the lid 464 and removes the TCT 66 from the box 368. Alternatively, the operator can remove the full box 368 from the fifth member 50, and replace the full box 368 with a new, empty box 368. At this time, the operator cuts the TCT 66 at a portion thereof near the feed gears 384, 386, and inserts the cut end of the TCT 66 into the new box 368. Alternatively, a container may be placed in the inside space of the box 238. In the last case, the operator replaces the container full of the collected TCT

66, with a new, empty container.

[0149] When the supplying of the ECs 60 advances and eventually the remaining amount of the current EC tape 62 wound on one supply reel 76 decreases to a small amount, the alarm device 532 and the display device 534 inform the operator of this situation and command him or her to connect another EC tape 62 to the current EC tape 62 now supplying the ECs 60. More specifically described, first, the operator removes the current EC tape 62 from the current supply reel 76, removes the current supply reel 76 from the bucket 78, sets another supply reel 76 in the bucket 78, and connects another EC tape 62 wound on the new supply reel 76, to the current EC tape 62 supplying the ECs 60. The connection of the two EC tapes 62 are carried out using the above-described metallic connection member 100 and the connection tape 102. In the present embodiment, another EC tape 62 which is to be connected to the terminal end portion 96 of the current EC tape 62 being fed by the EC-tape feeding device 90 to supply the ECs 60, is a new one which has not supplied any ECs 60. The respective operations of the alarm device 532 and the display device 534 will be described in detail later.

[0150] The first exclusive computer of the unit controller 500 monitors the connection of two EC tapes, according to the connection monitoring routine shown in Fig. 32. First, at Step S1, the computer judges whether identification information identifying an EC tape has been input. When the operator connects two EC tapes, he or her operates, before or after the connection, the bar-code reader 538 to read in the bar code 88 of the supply reel on which the following EC tape to be connected to the current or preceding EC tape 62 is wound, and the bar code printed on the bar-code seal 556 adhered to the EC-supply unit 32 feeding the preceding EC tape 62. The bar code of the EC-supply unit 32 is read in, in the state in which the movable handle member 552 is drawn out of the fixed handle member 550. Since the bar-code reader 538 is connected to the car-side controller 520, the car-side controller 520 sends, based on the identification information represented by the read-in bar code of the EC-supply unit 32, the identification information represented by the read-in bar code 88 of the following EC tape, to the unit controller 500 of that EC-supply unit 32. Thus, a positive judgment is made at Step S1.

[0151] On the other hand, if a negative judgment is made at Step S1, the control of the computer goes to Step S3 to judge whether a connection portion 103 has been detected. If a negative judgment is made at Step S3, the current control cycle according to this routine ends.

[0152] If a positive judgment is made at Step S1, the control goes to Step S2 to store the input identification information identifying the following EC tape, in the input-identification-information memory 506. In addition, the computer reads in a time which is measured by the

timer when a positive judgment is made at Step S1, and stores the read-in time in the identification-information-input-time memory 508. Step S2 is followed by Step S3. Since a connection-detect position where the detecting head 152 is provided is distant from a tape-connect position where the two EC tapes are connected to each other, a certain time is needed for the connection portion 103 to be fed from the tape-connect position to the connection-detect position. Therefore, at an early stage, a negative judgment is made at Step S3.

[0153] Whether the operator may have read in, or may have failed to read in, using the bar-code reader 538, the bar code 88 of the following EC tape, before or after connecting the two EC tapes to each other, a positive judgment is made at Step S3, when the connection portion 103 reaches the detecting head 152 and the connection member 100 electrically connects the two electrodes 166, that is, when the detecting head 152 detects the connection portion 103. Then, the control of the computer goes to Step S4 to judge whether any identification information is present in the input-identification-information memory 506. In the case where the operator has failed to read in the bar code 88 of the following EC tape when connecting the following EC to the preceding EC tape 62, no information is present in the memory 506 and a negative judgment is made at Step S4. Thus, the control goes to Step S5.

[0154] At Step S5, the computer sends, to the mounting-system controller 530 via the car-side controller 520, commands to operate the alarm device 532 and the display device 534 to inform and indicate that the operator has failed to read in the bar code 88 of the following EC tape, and stop the operation of the EC mounting system 16. More specifically described, the mounting-system controller 530 controls the alarm device 532 to generate an alarm sound, and controls the display device 534 to display a message that the operator has failed to read in the bar code, and indicate a particular EC-supply unit 32 which is feeding the following EC tape whose bar code 88 has not been read in. The mounting-system controller 530 can identify the particular EC-supply unit 32, based on the particular unit controller 500 which has sent the commands to operate the alarm device 532 and the display device 534. In addition, the controller 530 stops the operation of the EC mounting system 16.

[0155] The current control cycle ends with Step S5, and the computer starts with Step S1 in the next control cycle. If the operator reads in the bar code 88 of the following EC tape and inputs the identification information represented by the read-in bar code 88, a positive judgment is made at Step S1, and Steps S2 and S3 are performed. If the EC mounting system 16 is started again after the reading of the bar code 88, a connection-detect signal is virtually produced, and a positive judgment is made Step S3. Thus, Step S4 is performed. Since the identification information is present in the memory 506, a positive judgment is made at Step S4, and the control goes to Step S6. It is usual that the sys-

tem 16 is resumed after the reading of the bar code 88. Steps S1 and S3 are repeated till identification information is input and the system 16 is resumed.

[0156] Thus, in the present embodiment, it is judged whether identification information has been input when two EC tapes are connected to each other and, before the identification information is input, no ECs are mounted on a PWB 20. Thus, each EC-supply unit 32 is prevented from supplying ECs from an incorrect sort of EC tape, and the EC mounting system 16 is prevented from mounting an incorrect sort of ECs on a PWB 20.

[0157] If a positive judgment is made at Step S4, the control goes to Step S6 to read in a time which is measured by the timer when a positive judgment is made at Step S4, and store the read-in time in the connection-portion-detect-time memory 510. Step S6 is followed by Step S7 to subtract the time stored in the memory 508, from the time stored in the memory 510, and judge whether the thus obtained time difference is smaller than a reference time difference. Since Step S7 is carried out only when a positive judgment is made at Step S4 and Step S2 must have been carried out before Step S4, the computer can compare the time difference between the two times, with the reference time difference.

[0158] The above-indicated time-difference comparison is performed to exclude the identification information which has not been input in relation with the connection of two EC tapes 62, and avoid a wrong judgment that the identification information has been input in relation with the connection of two EC tapes. Since the connection-detect position and the tape-connect position are distant from each other, it needs a certain time for the connection portion 103 to be moved from the tape-connect position to the connection-detect position. This time can be estimated based on the distance between the tape-connect position and the connection-detect position (i.e., a length of the preceding EC tape 62 between the detecting head 152 and the connection member 100 when the two EC tapes are connected to each other); the pitch at which the ECs 60 are held by each EC tape 62; and the rate at which the each EC-supply unit 32 supplies the ECs 60 from the each EC tape 62, that is, whether or not the each unit 32 continuously supplies the ECs 60. Therefore, the reference time difference is predetermined to be somewhat longer than the thus estimated time. Thus, if the connection portion 103 is detected within the reference time difference after the following EC tape is connected to the preceding EC tape 62 and identification information is input, it can be judged that the input identification information is the identification information which has been input in relation with the connection of two EC tapes. In addition, the reference time difference is predetermined to be long enough to be able to judge that the input identification information is the identification information which has been input in relation with the connection of two EC tapes, even in the case where the operator reads in the bar code 88 of the following tape before connecting the

two EC tapes to each other.

[0159] On the other hand, if no connection portion 103 is detected within the reference time difference, a problem may have occurred. For example, in the present CB assembling system 10, after the EC mounting system 16 starts mounting the ECs 60 on the PWBs 20, the bar code 88 of one supply reel may be read in for some reason although, in fact, no EC tapes are connected. Even in this case, a positive judgment is made at Step S1 and, at Step S2, the time when the positive judgment is made is read in and stored, and the identification information is stored in the input-identification-information memory 506. If subsequently the operator does not fail to read in the bar code 88 of the following EC tape connected to the preceding EC tape 62, then new identification information represented by the read-in bar code 88 is stored in the memory 506 in place of the old identification information. In this case, therefore, no problem occurs. On the other hand, if the operator fails to read in, the memory 506 keeps the identification information which has not been input in relation with the connection of two EC tapes, and the identification information causes a positive judgment to be made at Step S4. In the latter case, however, since the identification information or bar code 88 has been input or read in a considerably long time before the two EC tapes are connected to each other, the time difference between the inputting of the identification information and the detection of the connection portion 103 is greater than the reference time difference. Thus, a negative judgment is made at Step S7, since it is judged that the identification information stored in the memory 506 cannot be the identification information input in relation with the connection of two EC tapes.

[0160] If a negative judgment is made at Step S7, the control of the computer goes to Step S8 to delete the information stored in the input-identification-information memory 506 and send, to the mounting-system controller 530 via the car-side controller 520, commands to stop the operation of the EC mounting system 16 and operate the alarm device 532 and the display device 534 to inform and indicate that identification information has been input, but not in relation with the connection of two EC tapes, and that the reading-in of the bar code 88 has not been done in relation with the connection of two EC tapes. After Step S8, the current control cycle ends, and the computer operates in the same manner as described above in the case where the reading-in of the bar code 88 has not been done and a negative judgment is made at Step S4.

[0161] If the time difference between the inputting of the identification information and the detection of the connection portion 103 is smaller than the reference time difference, a positive judgment is made at Step S7, and the control goes to Step S9 to judge whether the identification information identifying the following EC tape connected to the preceding EC tape 62 is identical with reference identification information identifying a

correct sort of EC tape 62 to be connected to the preceding tape 62. The reference identification information is supplied from the host computer 540 and is stored in the reference-identification-information memory 504. A negative judgment made at Step S9 means that the following EC tape actually connected to the preceding one 62 is not the correct sort of EC tape 62 to be connected to the preceding one 62. In this case, the control goes to Step S10 to produce a set of inappropriate-tape-connection information indicating that the input and stored identification information is not identical with the reference identification information. More specifically described, the set of inappropriate-tape-connection information includes information indicating that an incorrect sort of EC tape has been connected; information specifying a particular EC-supply unit 32 to which the incorrect sort of EC tape 62 has been connected; the identification information identifying the correct sort of EC tape 62 to be connected; and the identification information identifying the incorrect sort of EC tape 62 which has been actually connected. Step S10 is followed by Step S11 to delete the information stored in the memory 506 and send, to the mounting-system controller 530 via the car-side controller 520, commands to stop the operation of the EC mounting system 16, operate the alarm device 532 to inform the operator of the fact that an incorrect sort of EC tape 62 has been connected, and operate the display device 534 to display the set of inappropriate-tape-connection information. In addition, the computer sends the set of inappropriate-tape-connection information to the controller 530.

[0162] If a positive judgment is made at Step S9, the control goes to Step S12 to set, as a count number, C, of the remaining-amount counter 512, the sum of the number of ECs 60 held by the following EC tape 62 connected to the preceding one 62 and the number of ECs 60 held by the preceding one 62 between the connection-detect position and the EC-supply position. Since the distance between the connection-detect position and the EC-supply position is known in advance based on the designing of the each EC-supply unit 32, the computer can calculate, based on this distance and the pitch at which the ECs 60 are held by the each EC tape 62, the number of ECs 60 held by the preceding EC tape 62 between the connection-detect position and the EC-supply position. In addition, the computer deletes the information stored in the input-identification-information memory 506, since that information is no longer needed, in the present connection monitoring routine, after a positive or negative judgment is obtained at Step S9.

[0163] Step S12 is followed by Step S13 to judge whether one EC 60 has been supplied, that is, whether the EC sucker 22 has taken one EC 60 from one embossed portion 70. The computer makes this judgment based on the information supplied thereto from the mounting-system controller 530 which controls the EC taking operation of the EC sucker 22. If a positive judgment is made at Step S13, the control goes to Step S14

to subtract one from the count number C of the remaining-amount counter 512. Step S14 is followed by Step S15 to judge whether the count number C is equal to, or smaller than, a reference number,  $C_S$ . That is, the computer judges whether the remaining amount of the ECs 60 held by the EC tape 62 has decreased to a considerably small amount. At an early stage, a negative judgment is made at Step S15, and the control goes back to Step S13.

[0164] Steps S13 to S15 are repeated till a positive judgment is made at Step S15. Meanwhile, if a positive judgment is made at Step S15, the control goes to Step S16 to send, to the mounting-system controller 530 via the car-side controller 520, commands to operate the alarm device 532 and the display device 534 to inform and indicate that the remaining amount of the ECs 60 has decreased to the small amount. More specifically described, the computer sends information based on which the alarm device 532 generates an alarm sound requesting the operator to replenish a new EC tape 62, and based on which the display device 534 displays a message requesting the operator to replenish a new EC tape 62, and additionally displays the particular EC-supply unit 32 whose ECs 60 have decreased to the small amount, and the particular sort of EC tape 62 to be connected. Step S16 is followed by Step S17 to reset the count number C of the remaining-amount counter 512, to zero, and the current control cycle ends.

[0165] In the illustrated embodiment, the first member 42 as the main frame member can be used with each of the different sorts of sixth members 52, 269, 271 as the different sorts of tape-guide members which have different widths but are of a same type. However, a main frame member can be used with each of different sorts of tape-guide members which guide different types of EC tapes, respectively.

[0166] For example, Fig. 35 shows an EC-supply unit 700 including a main frame member 702 which can be used with each of an embossed-carrier-type ("ECT") tape-guide member 704 (Figs. 37 and 38) which guides an ECT EC tape and a punched-carrier-tape ("PCT") tape-guide member 706 (Figs. 39 and 40) which guides a PCT EC tape. The EC-supply unit 700 holds two EC tapes of a same sort, and can select one of the two EC tapes and supply ECs from the selected one EC tape. Two ECT tape-guide members 704, or two PCT tape-guide members 706 are attached to the EC-supply unit 700, such that the two ECT or PCT tape-guide members 704 or 706 are arranged side by side in the widthwise direction of the main frame member 702.

[0167] As shown in Figs. 35, 37, and 38, each ECT tape-guide member 704 has a shape like a column, extends in the lengthwise direction of the EC-supply unit 700, and has a groove 842 which allows the passing of the embossed portions 70 of an ECT EC tape. Two side walls which cooperate with each other to define the groove 842 therebetween provide respective support rails 844, 846 whose respective upper surfaces provide



respective support surfaces 848, 850 which support and guide the two end portions 68 of the ECT EC tape. Respective front portions of the bottom surface of the groove 842 and the two support surfaces 848, 850 are inclined downward in a forward direction to provide guide surfaces 854, 852, 856. Thus, the respective inclined portions of the bottom surface of the groove 842 and the two support surfaces 848, 850 cooperate with each other to introduce a portion of the carrier tape 64 from which the ECs have been supplied, in a downward direction toward a carrier-tape cutting device 496.

[0168] As shown in Fig. 37, each ECT tape-guide member 704 has two positioning holes 860, 862 at two locations distant from each other in the lengthwise direction thereof. The front or downstream-side positioning hole 860, as seen in the tape-feed direction, has a circular cross section, has a stepped shape, and includes a large-diameter portion 864 and a small-diameter portion 866. The rear or upstream-side positioning hole 862 also has a stepped shape, and includes an elongate or circular spot facing 868 and an elongate hole 870. A dimension of the elongate hole 870 as measured in a direction perpendicular to the EC-feed direction (i.e., in a direction parallel to the widthwise direction of each ECT EC tape) is equal to the diameter of the small-diameter portion 866 of the front positioning hole 860, and a dimension of the same 870 in a direction parallel to the EC-feed direction is greater than that diameter.

[0169] A PCT EC tape, not shown, includes (A) a carrier tape which includes (a1) a base tape having a number of through-holes, each formed through the thickness thereof, at a predetermined pitch in the lengthwise direction thereof, and (a2) a bottom cover tape closing respective lower openings of the through-holes of the base tape to define a number of EC accommodating pockets, and (B) a top cover tape which closes respective upper openings of the EC accommodating pockets. The bottom cover tape and the top cover tape are adhered to opposite major surfaces of the base tape, respectively, such that only one of opposite end portions of the base tape as seen in the widthwise direction thereof is not covered with the bottom or top cover tape. The one end portion of the base tape has a number of feed holes at a predetermined pitch in the lengthwise direction of the base tape. This pitch is equal to that at which the carrier tape 64 of an ECT EC tape has the feed holes 74. Like the ECT EC tape, the PCT EC tape is fed forward when a sprocket of an EC-tape feeding device that is engaged with the feed holes of the PCT EC tape is rotated.

[0170] As shown in Figs. 39 and 40, each PCT tape-guide member 706 does not have a groove 842 which allows the passing of the embossed portions 70 of an ECT EC tape, and an entire upper surface of the member 706 provides a support surface 710 which supports the bottom cover tape of a PCT EC tape. Except those differences, each PCT tape-guide member 706 has a

structure similar to each ECT tape-guide member 704, and the same reference numerals as used in describing each ECT tape-guide member 704 are used to designate the corresponding parts of each PCT tape-guide member 706. The height position of the support surface 710 of the PCT tape-guide member 706 is predetermined such that the height position of the upper surface of the PCT EC tape supported by the PCT tape-guide member 706 attached to the main frame member 702, is equal to that of the respective upper surfaces of the two end portions 68 of the carrier tape 64 of the ECT EC tape supported by the two support surfaces 848, 850 of the ECT tape-guide member 704 attached to the main frame member 702. That is, the height of the support surface 710 from the upper surface of the main frame member 702 is different from that of the support surfaces 848, 850.

[0171] A downstream portion of the support surface 710 as seen in a direction parallel to the EC-feed direction provides a guide surface 712 which is inclined downward in the EC-feed direction and which introduces the carrier tape 64 to the carrier-tape cutting device 496. The width of the front end portion of the PCT tape-guide member 706 decreases in the EC-feed direction. The PCT tape-guide member 706 has a vibration absorber 713 at a location corresponding to the EC-supply position of the EC-supply unit 700. The vibration absorber 713 may be formed of a vibration-control rubber which has the function of reducing vibration, or a foam material such as a sponge. Each EC stops on the vibration absorber 713 when being positioned at the EC-supply position. When the EC sucker 22 contacts the each EC, the impact is effectively absorbed by the vibration absorber 713, and the each EC is prevented from being damaged.

[0172] The ECT tape-guide member 704 or the PCT tape-guide member 706 is selectively attached to the main frame member 702, depending upon whether the EC-supply unit 700 feeds the ECT EC tape or the PCT EC tape. Thus, the tape-guide portion 708 is provided. The ECT or PCT tape-guide member 704 or 706 is positioned relative to, and fixed to, the main frame member 702 with two positioning bolts 872. To this end, the main frame member 702 has, as shown in Fig. 41, two positioning holes 874 at two locations distant from each other in a direction parallel to the EC-feed direction, and two internally threaded holes 876 each of which is coaxial with a corresponding one of the two positioning holes 874 and is continuous with the corresponding one hole 874. The diameter of each positioning hole 874 is equal to that of the small-diameter portion 866 of the positioning hole 860 of the ECT or PCT tape-guide member 704, 706. Fig. 42 shows one of the two positioning bolts 872. Each of the two bolts 872 includes a positioning shank portion 878, an externally threaded portion 880 which is provided at one of opposite ends of the shank portion 878 and which is threadably engageable with each internally threaded hole 876, and a



head portion 882 which is provided at the other end of the shank portion 878. The positioning shank portion 878 of each positioning bolt 872 has a diameter which allows the shank portion 878 itself to be fitted in each of each positioning hole 874 and the small-diameter portion 866 of each positioning hole 860, with substantially no space being left therebetween.

[0173] As shown in Figs. 35 and 36, a cover member 890 is attached to the main frame member 702, to prevent the ECT or PCT EC tape from moving up off the ECT or PCT tape-guide member 704 or 606. The cover member 890 has a generally inverted-U-shaped cross section, and has a pair of leg portions 892 in respective rear end portions (i.e., upstream-side end portions as seen in the EC-feed direction) of the two side walls thereof. With the two leg portions 892 fitted on an axis member 894, the cover member 890 is pivotable about an axis line parallel to the widthwise direction of the ECT or PCT EC tape.

[0174] A front end portion of the cover member 890 (i.e., a downstream-side end portion of the same 890 as seen in the EC-feed direction) is engaged with the main frame member 702 via an engaging member 900. The engaging member 900 has a generally inverted-U-shaped cross section, and is fitted on a front end portion of the ECT or PCT tape-guide member 704 or 706. The engaging member 900 has a pair of leg portions 902 projecting from two side walls 901 thereof. The two leg portions 902 are fitted on a front end portion of the main frame member 702 via an axis member 904, such that the engaging member 900 is pivotable about an axis line parallel to the axis line about which the cover member 890 is pivotable. The two leg portions 902 have respective elongate holes 906 through which the axis member 904 extends and which are elongate in a direction perpendicular to the axis line of pivotal motion of the engaging member 900. Thus, the engaging member 900 can be moved relative to the axis member 904.

[0175] The two side walls 901 of the engaging member 900 include respective engaging hook portions 910 which are opposite to the respective leg portions 901. The two engaging hook portions 910 are fitted in respective engaging recesses 912 formed in the two side walls of the cover member 890, such that the two hook portions 910 are engaged with respective lower portions of the two recesses 912 (more strictly, respective lower, inner surfaces of the two side walls of the cover member 890 that define the respective lower portions of the two recesses 912). A spring member 918 as an elastic member as a sort of biasing device is provided between the main frame member 702 and a tongue portion 916 provided between the two leg portions 902. The spring member 918 biases the engaging member 900 in a direction in which the engaging hook portions 910 of the engaging member 900 engage the engaging recesses 912. Thus, the cover member 890 is biased in a direction toward the main frame member 702, so that a front end portion of a top wall 920 of the cover member 890 con-

tacts the upper surface of the ECT or PCT EC tape being guided by the ECT or PCT tape-guide member 704 or 706 and presses the EC tape against the tape-guide member 704 or 706. Thus, the ECT or PCT EC tape is prevented from moving up off the support surfaces 848, 850 or the support surface 710. The front end portion of the top wall 920 of the cover member 890 provide a contact or press portion of the cover member 890.

[0176] The EC-supply unit 700 includes two EC-tape feeding devices 714 which have an identical structure. Each of the two EC-tape feeding devices 714 includes a sprocket 716 as a feed member; an electric motor (not shown) as a rotary drive source; a motion converting device (not shown) which includes a cam, a cam follower, a lever, and a link and which converts the rotation of the electric motor into a pivotal motion of a pivotable member 718; and a ratchet wheel 720 which is rotated forward (i.e., counterclockwise in Fig. 35), based on the pivotal motion of the pivotable member 718, to rotate the sprocket 716 and thereby feed the ECT or PCT EC tape. The structure of each EC-tape feeding device 714 is not relevant to the present invention, and accordingly the detailed description and illustration thereof is omitted. Each of the ECT and PCT tape-guide members 704, 706 has, as shown in Figs. 37 and 39, three recesses 722, 724, 726 which prevent the each tape-guide member 704, 706 from interfering with the sprocket 716, the ratchet wheel 720, and the pivotable member 718, respectively.

[0177] Next, there will be described the manner in which each ECT tape-guide member 704 is attached to the main frame member 702. First, the engaging member 900 is disengaged from the cover member 890, and subsequently the cover member 890 is pivoted about the axis member 894, so that the cover member 890 is retracted away from a portion of the main frame member 702 to which the each tape-guide member 704 is to be attached. More specifically described, the engaging member 900 is pivoted about the axis member 904 against the biasing force of the spring member 918, so that the engaging hook portions 910 are disengaged from the engaging recesses 912, and subsequently the cover member 890 is pivoted away from the main frame member 702.

[0178] Then, each ECT tape-guide member 704 is placed on the main frame member 702, and one positioning bolt 872 is inserted in the front positioning hole 860 of the tape-guide member 704 and the front positioning hole 874 of the main frame member 702, so that the externally threaded portion 880 of the one bolt 872 is screwed in the internally threaded hole 876 continuous with the front hole 874. In this state, the positioning shank portion 878 of the one bolt 872 is fitted in both the front positioning hole 874 of the main frame member 702 and the small-diameter portion 866 of the front positioning hole 860 of the tape-guide member 704, so that the ECT tape-guide member 704 is positioned relative to the main frame member 702. The externally threaded por-

tion 880 of the one positioning bolt 872 is screwed into the internally threaded hole 876, to a position where the head portion of the one bolt 872 is contacted with the bottom surface of the large-diameter portion 864 of the positioning hole 860.

[0179] Then, the other positioning bolt 872 is inserted in the rear positioning hole 862 of the ECT tape-guide member 704 and the rear positioning hole 874 of the main frame member 702, so that the externally threaded portion 880 of the other bolt 872 is screwed in the internally threaded hole 876 continuous with the rear hole 874. Since the elongate hole 870 as a portion of the rear hole 862 is longer, in a direction parallel to the EC-feed direction, than the diameter of the small-diameter portion 866 of the front positioning hole 860, i.e., the diameter of each positioning hole 874, the externally threaded portion 880 of the other bolt 872 can be surely screwed in the internally threaded hole 876 even if there may be a positional error between the rear hole 862 and the rear hole 874 in the direction parallel to the EC-feed direction. The width of the elongate hole 870 is equal to the diameter of the small-diameter portion 866, and the positioning shank portion 878 of the other bolt 872 is fitted in both the rear positioning hole 874 and the elongate hole 870 of the rear positioning hole 860, so that the ECT tape-guide member 704 is positioned relative to the main frame member 702 in the widthwise direction of the same 702 and additionally is prevented from rotating relative to the same 702. The externally threaded portion 880 of the other bolt 872 is screwed into the internally threaded hole 876, to a position where the head portion 882 of the other bolt 872 is contacted with the bottom surface of the spot facing 868 of the rear hole 862. Thus, the ECT tape-guide member 704 is positioned relative to, and fixed to, the main frame member 702 on a horizontal plane. In addition, the top surface of the main frame member 702 and the bottom surface of the tape-guide member 704 cooperate with each other to position the two members 702, 704 in a vertical direction perpendicular to the widthwise and lengthwise directions of the same 702, 704. The top surface of the main frame member 702 and the bottom surface of the tape-guide member 704 provide two positioning surfaces extending parallel to the widthwise direction of each EC tape and the EC-feed direction.

[0180] After each ECT tape-guide member 704 is fixed to the main frame 702, the embossed portions 70 of the ECT EC tape are fitted in the groove 842 of the tape-guide member 704, so that the two end portions 68 of the ECT EC tape are supported on the two support surfaces 848, 850, respectively, and the feed holes 74 of the ECT EC tape are engaged with the projections of the sprocket 716. Subsequently, the cover member 890 is pivoted onto the ECT tape-guide member 704 and the EC tape, and the engaging member 900 is engaged with the cover member 890. More specifically described, the engaging member 900 is pivoted while being moved against the biasing force of the spring member 918, and

the engaging hook portions 910 are engaged with the engaging recesses 912 of the cover member 890. If the operator releases his or her fingers off the engaging member 900, the two hook portions 910 automatically engage the respective lower portions of the two recesses 912, so that the cover member 890 is biased by the spring member 918 toward the ECT tape-guide member 704. Thus, the front end portion of the cover member 890 that is located on a downstream side of a place where the carrier tape 64 of the ECT EC tape is engaged with the sprocket 716, as seen in the EC-feed direction, is contacted with the upper surface of the ECT EC tape, so that the two end portions 68 of the ECT EC tape are pressed against the two support surfaces 848, 850, respectively, and accordingly are prevented from moving up off the same 848, 850. The ECT EC tape is positioned in its widthwise direction, because its embossed portions 70 are positioned by the pair of side walls defining the groove 842 and/or its end portions 68 are positioned by the two side walls of the cover member 890.

[0181] When the EC-supply unit 700 is used to supply the ECs from the PCT EC tapes, the two ECT tape-guide members 704 are replaced with the two PCT tape-guide members 706. First, each of the two engaging members 900 is disengaged from a corresponding one of the two cover members 890, and each of the two cover members 890 is pivoted away from a corresponding one of the two tape-guide members 704. Then, the two positioning bolts 872 are removed and each of the two tape-guide members 704 is removed from the main frame member 702.

[0182] Then, each of the two PCT tape-guide members 706 is placed on the main frame member 702, and is positioned relative to, and fixed to, the same 702 with the two positioning bolts 872 and the positioning holes 860, 862, 874, like each ECT tape-guide member 704. Thereafter, two PCT EC tapes are placed on the respective support surfaces 710 of the two PCT tape-guide members 706, subsequently the two cover members 890 are pivoted to cover the respective PCT EC tapes and the respective tape-guide members 706, and then the two engaging members 900 are engaged with the respective cover members 890. In the case of the PCT tape-guide members 706, the two side walls of each cover member 890 prevent the PCT EC tape from moving in its widthwise direction, and thereby position the same in its widthwise direction. In addition, the front end portion of the top wall of the each cover member 890 contacts the upper surface of the PCT EC tape, and presses the EC tape against the support surface 710, thereby preventing the tape from moving up off the support surface 710. The ECT tape-guide members 704 and the PCT tape-guide members 706 are manufactured such that when the ECT tape-guide members 704 attached to the main frame member 702 guide the ECT EC tapes, the respective upper surfaces of the ECT EC tapes take the same height as that taken by the respective upper surfaces of the PCT EC tapes when the PCT

tape-guide members 706 attached to the main frame member 702 guide the PCT EC tapes. Thus, the common cover members 890 effectively prevent those different sorts of EC tapes from moving up off the different sorts of tape-guide members 704, 706.

[0183] It is possible that a common tape-guide member guide each of different types of EC tapes. For example, Fig. 43 shows a cover member 730 which is employed in an EC-supply unit 732 in which a common tape-guide member guides each of different types of EC tapes. The cover member 730 is attached, like the above-described cover members 890, to a main frame member 702 via an axis member 894 such that the cover member 730 is pivotable about an axis line parallel to the widthwise direction of each EC tape, and is engaged with an engaging member 900 so that the cover member 730 is biased by a spring member 918 in a direction toward the main frame member 702.

[0184] The cover member 730 has a generally inverted-U-shaped cross section and, as shown in Fig. 43, includes a sheet or leaf spring 736 which is integral with the remaining portion of a top wall 734 of the cover member 730 and which is elastically deformable in a vertical direction in which the sheet spring 736 is moved toward, and away from, the top wall 734. The sheet spring 736 is provided by a cut and bent portion of the top wall 734 that is located on an upstream side, as seen in the EC-feed direction, of a place where an EC-tape feeding device 714 is engaged with each EC tape, that is, where the projections of a sprocket 716 are engaged with the feed holes of the carrier tape of each EC tape. The sheet spring 736 is bent toward each EC tape, i.e., the common tape-guide member.

[0185] Fig. 44 shows an ECT (embossed-carrier-type) tape-guide member 704 which is attached as the common tape-guide member to the main frame member 702. The ECT tape-guide member 704 guides each of an ECT EC tape 740 (Fig. 46) and a PCT (punched-carrier-type) EC tape 742 (Fig. 47). Fig. 46 shows the case where the ECT tape-guide member 704 guides the ECT EC tape 740. More specifically described, a pair of end portions 68 of the ECT tape 740 are supported on two support surfaces 848, 850, and embossed portions 70 are fitted in a groove 842. Fig. 47 shows the case where the ECT tape-guide member 704 guides the PCT EC tape 742. More specifically described, a pair of opposite end portions of the PCT tape 742 that extend parallel to each other in the lengthwise direction of the tape 742 are supported on the two support surfaces 848, 850, respectively, and guided by the same 848, 850, respectively.

[0186] Since the thickness of the end portions 68 of the ECT EC tape 740 is smaller than the overall thickness of the PCT EC tape 742 (i.e., the sum of the thickness of the carrier tape and the thickness of the top cover tape), the height of the upper surface of the PCT tape 742 guided by the ECT tape-guide member 704, as measured from the support surfaces 848, 850 of the

same 704, is higher than that of the upper surface of the ECT tape 740 guided by the same 704. The upper surface of the ECT tape 740 includes the respective upper surfaces of the two end portions 68.

5 [0187] Therefore, in the case where the ECT tape-guide member 704 guides the ECT EC tape 740, the front end portion of the cover member 730 is inclined downward, as shown in Figs. 44 and 48. In addition, the distance between the cover member 730 and the ECT  
10 tape 740 increases in a direction toward the axis member 894 about which the cover member 730 is pivotable. In Fig. 48, the inclination of the cover member 730 is exaggerated. However, the cover member 730 has the sheet spring 736, and the sheet spring 736 contacts the  
15 ECT tape 740 and presses the two end portions 68 against the two support surfaces 848, 850, respectively, thereby preventing the tape 740 from moving up off the same 848, 850. Thus, on a downstream side of the place where the ECT tape 740 is engaged with the projections  
20 of the sprocket 716, the ECT tape 740 is pressed on the support surfaces 848, 850 by the front end portion of the top wall 734 of the cover member 730 and, on an upstream side of that place, the ECT tape 740 is pressed  
25 on the support surfaces 848, 850 by the sheet spring 736 of the top wall 734 of the cover member 730. Thus, the ECT tape 740 is surely prevented from moving up off the support surfaces 848, 850. In the present embodiment, each of the front end portion and the sheet spring 736 of the top wall 734 provides a contact or press portion of the cover member 730.  
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[0188] Meanwhile, in the case where the ECT tape-guide member 704 guides the PCT EC tape 742, as shown in Fig. 47, the front end portion of the cover member 730 is not inclined so much, as shown in Fig. 45,  
35 since the PCT tape 742 is thicker than the ECT tape 740. However, the sheet spring 736 is elastically deformed toward the top wall 734, thereby allowing the passing of the PCT tape 742, and is contacted with the same 742 to press the same 742 against the support  
40 surfaces 848, 850, thereby preventing the same 742 from moving up off the surfaces 848, 850. Thus, the cover member 730 contacts the PCT tape 742 at two locations on the downstream and upstream sides, as seen in the EC-feed direction, of the place where the PCT  
45 tape 742 is engaged with the sprocket 716, thereby preventing the PCT tape 742 from moving up off the support surfaces 848, 850.

[0189] A common tape-guide member may guide each of different types of EC tapes, in different manners than the above-described manner. For example, the PCT tape-guide member 706 can support and guide, on its support surface 710, each of the bottom cover tape of the PCT EC tape 742 and the respective lower surfaces of the embossed portions 70 of the ECT EC tape  
50 740.

[0190] In the above case, the PCT tape-guide member 706 may be used with a cover member having a sheet spring, like the cover member 730. In this case,

the cover member accommodates the difference between the respective heights of the upper surfaces of the different types of EC tapes, and contacts the EC tape of each type at two locations on the downstream and upstream sides, as seen in the EC-feed direction, of the place where the EC tape is engaged with the EC-tape feeding device, thereby effectively preventing the EC tape from moving up off the support surface 710.

[0191] In the case where a common tape-guide member 704, 706 guides each of different types of EC tapes 740, 742, a cover member may be attached to either a main frame member 702, or the common tape-guide member 704, 706. In a particular case where the frame of the EC-supply unit 700, 732 is not separable into a main frame member and a tape-guide member, the cover member is attached to the frame.

[0192] A cover member, such as the cover member 730, which includes two contact or press portions for contacting or pressing the upper surface of each EC tape, at two locations on the downstream and upstream sides, as seen in the EC-feed direction, of the place where the each EC tape is engaged with the EC-tape feeding device, may be employed in an EC-supply unit (e.g., the EC-supply unit 700), in which each of exclusive tape-guide members (e.g., the ECT and PCT tape-guide members 704, 706) corresponding to different types of EC tapes is selectively attached to a main frame member. For example, in the EC-supply unit 700 shown in Figs. 35 to 42, each of the ECT and PCT tape-guide members 704, 706 may be used to guide each of different sorts of EC tapes having different thickness values. The thickness value of each sort of PCT EC tape is defined as the sum of the thickness of the carrier tape thereof and the thickness of the top cover tape thereof, and the thickness of each sort of ECT EC tape is defined as the thickness of the end portions 68 of the carrier tape 64 thereof. Respective upper surfaces of different sorts of PCT or ECT EC tapes having different thickness values have different heights as measured from the support surface 710 or surfaces 848, 850 of the PCT or ECT tape-guide member 706, 704. However, if the cover member 730 is employed, the cover member 730 contacts and presses the upper surface of each sort of EC tape, irrespective of the thickness of the each EC tape, at two locations on the downstream and upstream sides, as seen in the EC-feed direction, of the place where the each EC tape is engaged with the EC-tape feeding device, thereby preventing the each EC tape from moving up off the support surface 710 or surfaces 848, 850 of the PCT or ECT tape-guide member 706, 704.

[0193] An ECT tape-guide member and a PCT tape-guide member may be manufactured such that the two sorts of tape-guide members have different EC-tape guiding portions but have identical shapes and dimensions and such that when each of the two sorts of tape-guide members is attached to a main frame member, the height of the two support surfaces of the ECT tape-guide member as measured from the upper surface of

the main frame member is equal to that of the support surface of the PCT tape-guide member. In this case, since the thickness of the end portions 68 of the ECT EC tape is smaller than that of the PCT EC tape, the upper surface of the PCT tape guided by the PCT tape-guide member is higher than that of the ECT tape guided by the ECT tape-guide member. However, if the cover member 730 is employed in this case, the cover member 730 can accommodate the difference between the respective upper surfaces (i.e., the respective thickness values) of the two types of EC tapes.

[0194] In short, in the case where the respective heights of the respective support surfaces of the ECT and PCT tape-guide members are equal to each other, the cover member 730 accommodates the difference between the respective thickness values of different types of EC tapes, e.g., the ECT and PCT EC tapes (and possibly accommodates the difference between the respective thickness values of different sorts of EC tapes each of a same type). Meanwhile, in the case where the respective heights of the respective support surfaces of the ECT and PCT tape-guide members differ from each other, the cover member 730 accommodates the difference between the respective thickness values of different sorts of EC tapes each of a same type.

[0195] In the second embodiment shown in Figs. 35 to 42, the two tape-guide members of a same type 704 or 706 are attached to the main frame member 702. However, it is possible that two tape-guide members 704, 706 of different types be attached to the main frame member 702. In this case, the single EC-supply unit 700 can supply ECs from two EC tapes of different types.

[0196] In the second embodiment shown in Figs. 35 to 42, the two tape-guide members of each of the different types 704, 706 which guide the different types of EC tapes, respectively, are selectively attached to the common, single main frame member 702 of the EC-tape supply unit 700 which supplies the ECs from the two EC tapes being guided by the two tape-guide members. However, it is possible that a single tape-guide member of each of the different types 704, 706 be selectively attached to a main frame member of an EC-tape supply unit which supplies ECs from a single EC tape being guided by the single tape-guide member. In this case, it is further possible to employ different sorts of tape-guide members which belong to each one of the different types 704, 706, which include respective EC-tape guiding portions whose widths differ from each other, and which are used to guide different sorts of EC tapes having different widths.

[0197] In the first embodiment, the EC-tape feeding device 90 which feeds each EC tape includes the motion converting device 302 which includes the cam (i.e., the plate cam 306) and the cam follower (i.e., the bell-crank lever 308) and which converts the rotation of the stepper motor 300 as the rotary drive source into the respective reciprocative pivotal motions of the two pivotable members (280, 282), and the two one-way pivotal-motion

transmitting devices (i.e., the ratchet wheel 276 and the two ratchet pawls 284, 286) which transmit the respective forward pivotal motions of the two pivotable members to the feed member (i.e., the sprocket 272). However, the EC-tape feeding device is not limited to the illustrated one 90. For example, the feeding device may employ a double-action fluid-pressure-operated cylinder device (e.g., a double-action air-pressure-operated cylinder device) as a sort of reciprocal drive source, and a motion converting device which converts the reciprocative motion of a reciprocative drive member of the fluid-pressure-operated cylinder device into the respective reciprocative pivotal motions of the two pivotable members. Otherwise, it is possible to pivot, based on a drive force of a drive source which is separate from each EC-supply unit, the two pivotable members and thereby cause the feed member to feed each EC tape. In each of the latter cases, it may, or may not, employ a cam and a cam follower to control the velocity of each of the two pivotable members.

[0198] In the first embodiment, the EC-tape feeding device 90 includes the two pivotable members 280, 282. However, the EC-tape feeding device 90 may be modified to include only a single pivotable member.

[0199] In the first embodiment, the sprocket 272 is employed as the feed member. However, the feed member is not limited to the sprocket 272. For example, the feed member may be provided by a feed belt which is wound on two or more pulleys and is circulated as one or more of the pulleys are rotated, and which has a plurality of projections engaging the feed holes of each EC tape.

[0200] In the first embodiment, the cover member 210 may be attached to the frame 40, such that the cover member 210 is movable in synchronism with the feeding of each EC tape, for example, such that when the each EC tape is fed, the cover member 210 is moved with the each tape while covering the each tape being fed. When the EC sucker 22 takes each EC from the each EC tape, the cover member is retracted away from above the leading EC being positioned at the EC-supply position.

[0201] In the first embodiment, the tables 30 on which the EC-supply units 32 are attached are fixed in position when the ECs 60 are mounted on the PWBs 20. It is possible to employ a table moving device which moves each of the tables 30 along a straight line along which the respective EC-supply portions of the EC-supply units are arranged, so that each of the EC-supply portions may be positioned at a single EC-supply position where each EC 60 is supplied from the each EC-supply portion. This EC-supply position is located on the path of movement of the EC-supply portions.

[0202] In each of the illustrated embodiments, after the EC sucker 22 takes one EC 60 from one embossed portion 70 of each EC tape, the EC-supply unit 32, 700, 732 feeding the each EC tape waits for supplying the next EC 60, in the state in which the emptied embossed portion 70 remains at the EC-supply position of the unit

32, 700, 732. However, it is possible that the unit 32, 700, 732 wait for supplying the next EC 60, in the state in which the next EC 60 is fed to, and held at, the EC-supply position of the unit 32, 700, 732. That is, after the EC sucker 22 takes one EC 60 from one embossed portion 70 of each EC tape, the each EC tape is immediately fed so that the next EC 60 is moved to, and kept at, the EC-supply position of the unit 32, 700, 732.

[0203] In each of the illustrated embodiments, the TCT feeding device 366 feeds the TCT 66 while peeling the same 66 from the carrier tape 64, and collects the same 66 in the TCT collecting box 368. However, it is possible to treat the TCT 66 peeled from the carrier tape 64, in different manners. For example, it is possible to employ a take-up reel which takes up the peeled TCT 66, or an introduction pipe which introduces the peeled TCT 66 to a TCT collecting space.

[0204] In the first embodiment, the position of the cover member 210 can be changed in steps in a direction parallel to the EC-feed direction, and the cover member 210 can be fixed to the first member 42 by the fixing device (i.e., the screw 252) in the same direction. However, it is not essentially required that the cover member 210 be fixed to the first member 42, and it is possible that the cover member 210 be only positioned relative to the first member 42 with the conical holes 256 and the ball plungers 258. In the latter case, the screw 252 used to fix the slide member 214 to the first member 42 is replaced with a stepped screw which prevents the slide member 214 from moving up off the first member 42, while allowing the movement of the slide member 214. The stepped screw includes a shank portion, a head portion which is provided at one of axially opposite ends of the shank portion and whose diameter is greater than that of the shank portion, and a threaded portion which is provided at the other end of the shank portion and whose diameter is smaller than that of the shank portion. The stepped screw is screwed into the first member 42 through the through-hole 248 of the sixth member 52 and the elongate hole 250 of the slide member 214. The shank portion has a length which assures that the slide member 214 is movably sandwiched between the head portion and the first member 42 and is prevented from moving up off the first member 42. Thus, the position of the cover member 210 in the direction parallel to the EC-feed direction can be changed by moving the slide member 214 in the state in which the stepped screw is threadably engaged with the first member 42.

[0205] In each of the illustrated embodiments shown in Figs. 35 to 48, the cover member 890, 730 may be attached to the frame by a cover-member attaching device which attaches the cover member 890, 730 to the frame such that the position of the cover member 890, 730 in the direction parallel to the EC-feed direction is changeable.

[0206] It is to be understood that the present invention may be embodied with other changes, improvements,

and modifications that may occur to one skilled in the art without departing from the scope of the invention defined in the appended claims.

[0207] Each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features.

[0208] Statements in this specification of the "objects of the invention" relate to preferred embodiments of the invention, but not necessarily to all embodiments of the invention falling within the claims.

[0209] The description of the invention with reference to the drawings is by way of example only.

[0210] The text of the abstract filed herewith is repeated here as part of the specification.

[0211] An electric-component supplying unit (32) for feeding an electric-component tape which includes a carrier tape and holds a plurality of electric components at a predetermined pitch in a lengthwise direction of the carrier tape, and supplying the electric components, one by one, from the electric-component tape, the supplying unit including a frame (40) including a tape-guide portion (192) which guides the electric-component tape, a feeding device (90) which feeds, in the lengthwise direction, the electric-component tape being guided by the tape-guide portion, and positions the electric components, one by one, at a component-supply position, and the frame comprising a main frame member (42), and at least one tape-guide member (52, 269, 271) which is detachably attached to the main frame member, the main frame member and the tape-guide member attached thereto cooperating with each other to provide the tape-guide portion.

## Claims

1. An electric-component supplying unit (32/700/732) for feeding an electric-component tape which includes a carrier tape and holds a plurality of electric components at a predetermined pitch in a lengthwise direction of the carrier tape, and supplying the electric components, one by one, from the electric-component tape, the supplying unit comprising:

a frame (40) including a tape-guide portion (192/708) which guides the electric-component tape;

a feeding device (90/714) which feeds, in said lengthwise direction, the electric-component tape being guided by the tape-guide portion, and positions the electric components, one by one, at a component-supply position; and the frame comprising a main frame member (42/702), and at least one tape-guide member (52, 269, 271/704, 706) which is detachably attached to the main frame member and provides the tape-guide portion (192/708).

2. An electric-component supplying unit according to claim 1, further comprising a positioning device (208, 209, 242, 244, 247/860, 862, 874, 878) which accurately positions the tape-guide member relative to the main frame member; and a fixing device (246/876, 880, 882) which fixes the tape-guide member to the main frame member.
3. An electric-component supplying unit according to claim 2, wherein the main frame member has at least one first positioning hole (874) and at least one internally threaded hole (876) which is coaxial, and continuous, with said at least one first positioning hole, wherein the tape-guide member has at least one second positioning hole (860, 862), and wherein the supplying unit further comprises at least one positioning bolt (872) including (a) a positioning shank portion (878) which is fitted in the first and second positioning holes to position the main frame member and the tape-guide member relative to each other, (b) an externally threaded portion (880) which is provided at one of axially opposite ends of the shaft portion and which is screwed into the internally threaded hole, and (c) a head portion (882) which is provided at the other end of the shaft portion and which is engaged with the tape-guide member, the positioning device comprising the first and second positioning holes and the positioning shank portion of the positioning bolt, the fixing device comprising the internally threaded hole, and the externally threaded portion and the head portion of the positioning bolt.
4. An electric-component supplying unit according to any one of claims 1 to 3, wherein said at least one tape-guide member comprises an embossed-carrier-type-electric-component-tape guide member (704) corresponding to an embossed-carrier-type electric-component tape including a plurality of embossed portions, and a punched-carrier-type-electric-component-tape guide member (706) corresponding to a punched-carrier-type electric-component tape, each one of the two types of tape-guide members being selectively attached to the main frame member (702) to provide the tape-guide portion (708) which guides a corresponding one of the two types of electric-component tapes.
5. An electric-component supplying unit according to claim 4, wherein the embossed-carrier-type-electric-component-tape guide member (704) and the punched-carrier-type-electric-component-tape guide member (706) are different from each other in that the embossed-carrier-type-electric-component-tape guide member has a groove (842) which allows the embossed portions of the embossed-carrier-type electric-component tape to pass there-through and the punched-carrier-type-electric-com-

ponent-tape guide member does not have said groove.

6. An electric-component supplying unit according to any one of claims 1 to 5, wherein said at least one tape-guide member comprises a plurality of sorts of tape-guide members (52, 269, 271) corresponding to a plurality of sorts of electric-component tapes having different widths, respectively, each one of said plurality of sorts of tape-guide members being selectively attached to the main frame member (42) to provide the tape-guide portion (192) which guides a corresponding one of said plurality of sorts of electric-component tapes that has a corresponding one of said different widths.
7. An electric-component supplying unit according to claim 1, wherein said at least one tape-guide member comprises a plurality of sorts of tape-guide members which include (a) respective guiding portions (190) which are different from each other and which guide a plurality of sorts of electric-component tapes, respectively, (b) respective attachable portions (208, 209) which are identical with each other and each of which is attachable to the main frame member, and (c) respective feeding-device-related portions (198, 202) which are identical with each other and each of which is related to the feeding device.
8. An electric-component supplying unit according to claim 7, wherein said plurality of sorts of tape-guide members have said respective guiding portions (190) in respective one side portions thereof, and have said respective attachable portions (208, 209) and said respective feeding-device-related portions (198, 202) in the respective other side portions thereof.
9. An electric-component supplying unit according to any one of claims 1 to 8, further comprising a cover member (210/890/730) which prevents the electric-component tape from moving off the tape-guide member (52, 269, 271/704, 706).
10. An electric-component supplying unit according to claim 9, wherein the cover member (210) is attached to the tape-guide member (52, 269, 271).
11. An electric-component supplying unit according to claim 9 or claim 10, wherein the tape-guide member (704) has at least one support surface (848, 850) which supports and guides a lower surface of each of a plurality of sorts of electric-component tapes (740, 742) having respective upper surfaces whose respective heights from the support surface differ from each other, and wherein the cover member (730) includes two contact portions (734, 736)

which contact and press, against the support surface, said each sort of electric-component tape at two locations on an upstream side and a downstream side of a place where said each sort of electric-component tape is engaged with the feeding device (714), in a direction in which said each sort of electric-component tape is fed by the feeding device.

12. An electric-component supplying unit (732) for feeding each of a plurality of sorts of electric-component tapes (740, 742) each of which includes a carrier tape and holds a plurality of electric components at a predetermined pitch in a lengthwise direction of the carrier tape, and supplying the electric components, one by one, from said each sort of electric-component tape, the supplying unit comprising:

a frame (702) having at least one support surface (848, 850) which supports and guides a lower surface of said each of said plurality of sorts of electric-component tapes having respective upper surfaces whose respective heights from the support surface differ from each other;

a feeding device (714) which feeds, in said lengthwise direction, said each sort of electric-component tape being guided by the support surface of the frame, and positions the electric components of said each sort of electric-component tape, one by one, at a component-supply position; and

a cover member (730) which is attached to the frame and which prevents said each sort of electric-component tape from moving off the support surface of the frame, the cover member including two contact portions (734, 736) which contact and press, against the support surface, said each sort of electric-component tape at two locations on an upstream side and a downstream side of a place where said each sort of electric-component tape is engaged with the feeding device, in a direction in which said each sort of electric-component tape is fed by the feeding device.

13. An electric-component supplying unit according to claim 12, wherein the cover member (730) is attached to the frame (702) such that the cover member is pivotable about an axis line parallel to a widthwise direction of said each sort of electric-component tape, and one of said two contact portions of the cover member comprises an elastic member (736) which is elastically deformable in a direction substantially perpendicular to said at least one support surface.

14. An electric-component supplying unit according to claim 13, wherein the elastic member comprises a sheet spring (736) including a base end portion which is connected to the cover member, and a free end portion which contacts and presses said each sort of electric-component tape. 5
15. An electric-component supplying unit according to claim 14, wherein the sheet spring is provided by an integral portion (736) of the cover member (730). 10
16. An electric-component supplying unit (32) for feeding an electric-component tape which includes a carrier tape and holds a plurality of electric components at a predetermined pitch in a lengthwise direction of the carrier tape, and supplying the electric components, one by one, from the electric-component tape, the supplying unit comprising: 15
- a frame (40) having a tape-guide portion (192) which guides the electric-component tape; 20
- a feeding device (90) which feeds, in said lengthwise direction, the electric-component tape being guided by the tape-guide portion, and positions the electric components, one by one, at a component-supply position; 25
- a cover member (210) which is attached to the frame and which prevents the electric-component tape from moving off the frame; and 30
- a cover-member attaching device (268) which attaches the cover member to the frame such that a position of the cover member in a tape-feed direction in which the electric-component tape is fed by the feeding device is changeable. 35
17. An electric-component supplying unit according to claim 16, wherein the cover-member attaching device comprises a stepwise position changing device (266) which changes the position of the cover member to each of a plurality of steps corresponding to a plurality of positions in said tape-feed direction, respectively. 40
18. An electric-component supplying unit according to claim 17, wherein the stepwise position changing device comprises: 45
- a slide member (214) which is attached to the frame such that the slide member is movable relative to the frame in a direction parallel to said tape-feed direction; 50
- an attaching device (226, 232) which attaches the cover member to the slide member;
- a rigid engaging portion (256) which is provided by one of the frame and the slide member; and 55
- an elastic engaging portion (258) which is provided by the other of the frame and the slide member and which elastically engages the rigid

engaging portion.

19. An electric-component supplying unit according to claim 18, wherein the rigid engaging portion comprises a plurality of engaging holes (256) which are formed in said one of the frame and the slide member such that the engaging holes are distant from each other in said tape-feed direction, and wherein the elastic engaging portion comprises an elastic member (264) and an engaging projection (260) which projects from the other of the frame and the slide member such that the engaging projection is not movable in said tape-feed direction and is movable in opposite directions in which the engaging projection engages, and disengages from, each of the engaging holes and which is biased by the elastic member in one of the opposite directions in which the engaging projection engages said each engaging hole.



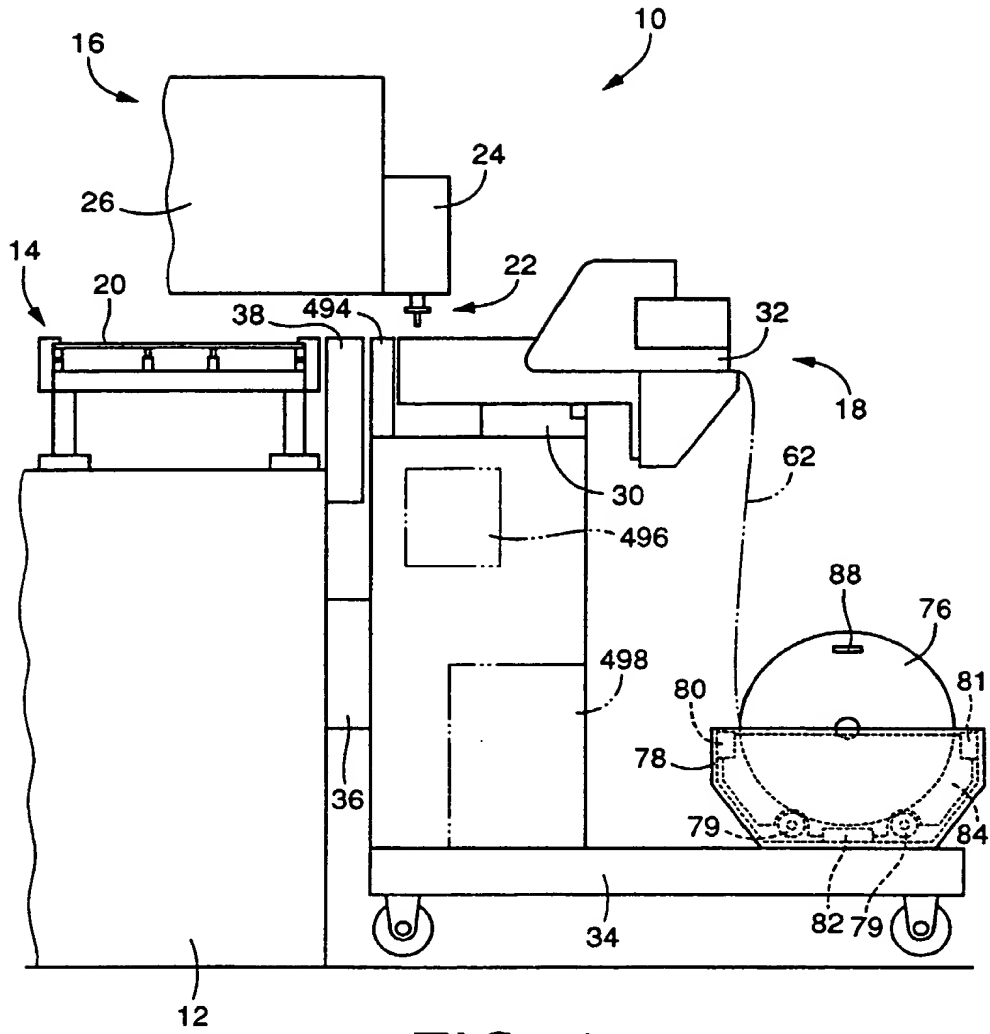


FIG. 1

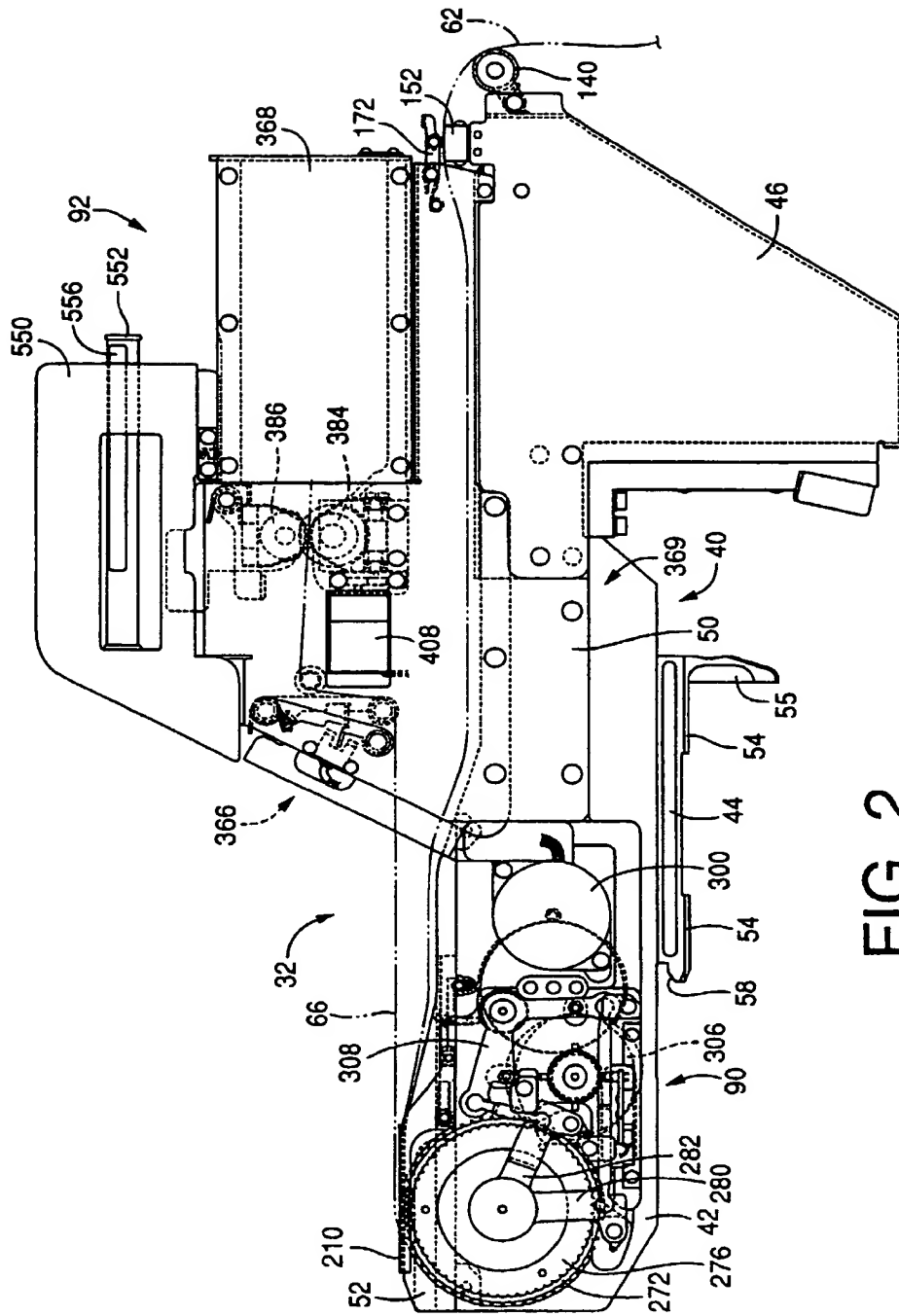


FIG. 2

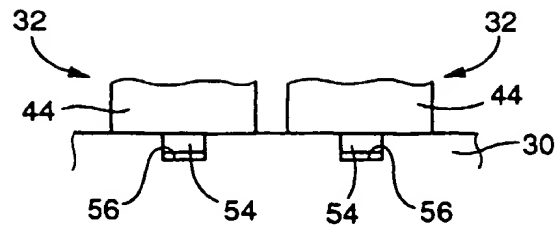


FIG. 3

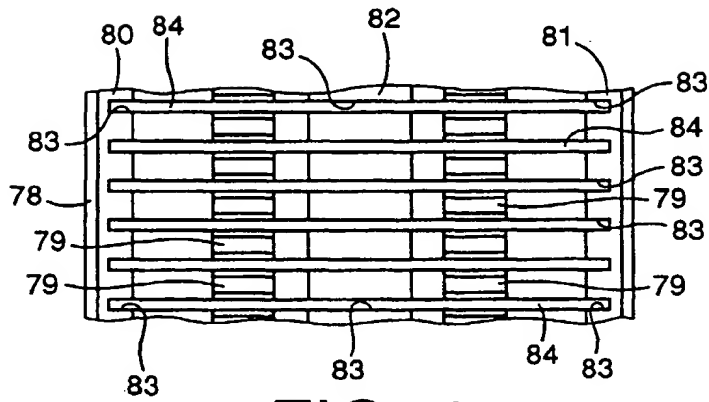


FIG. 4

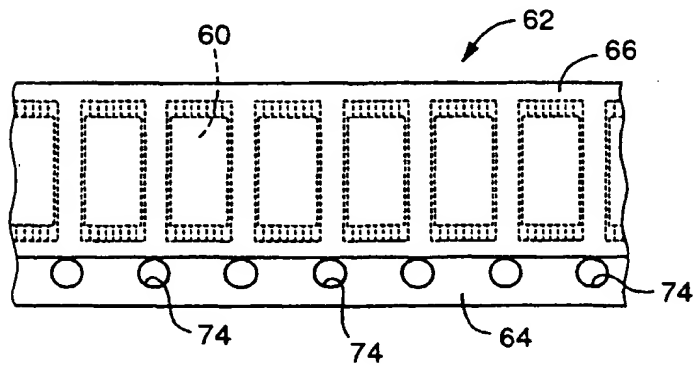


FIG. 5

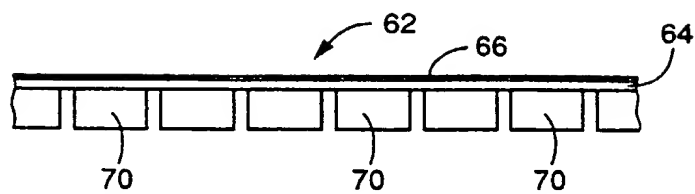


FIG. 6

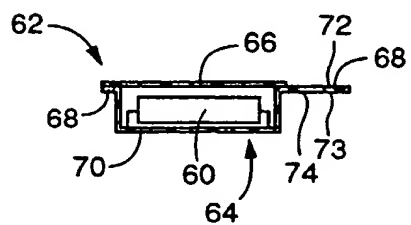


FIG. 7

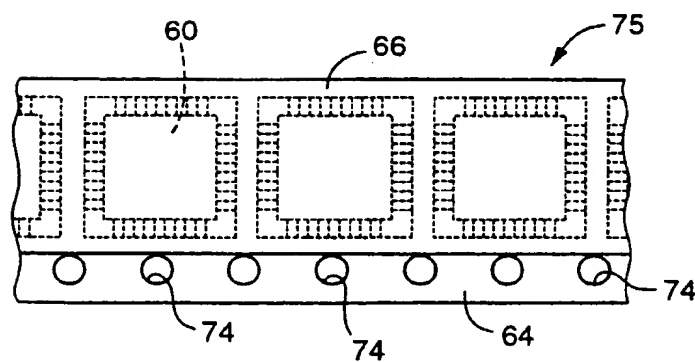


FIG. 8

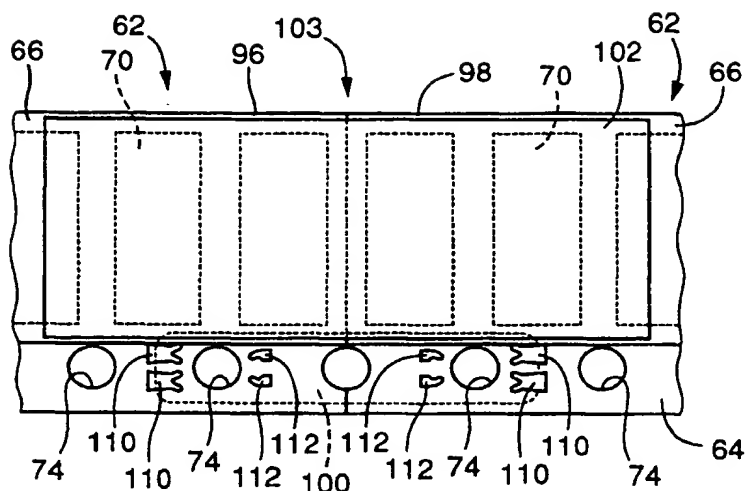


FIG. 9

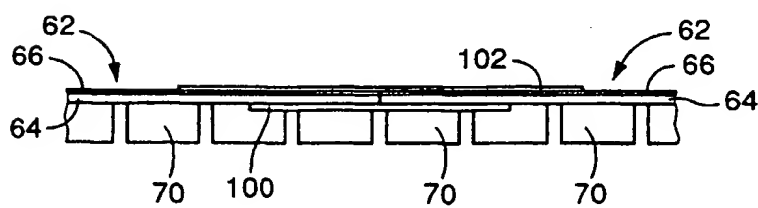


FIG. 10

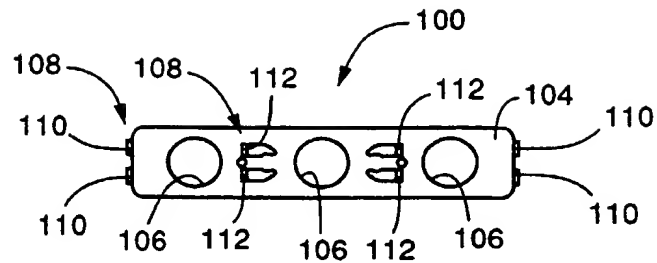


FIG. 11

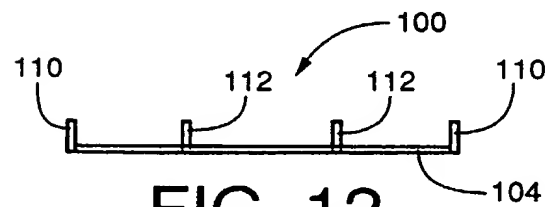


FIG. 12

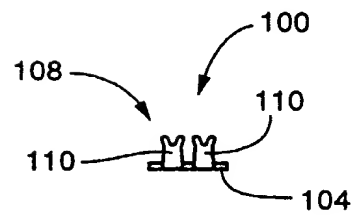


FIG. 13

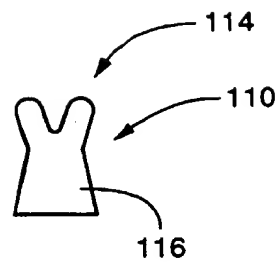


FIG. 14

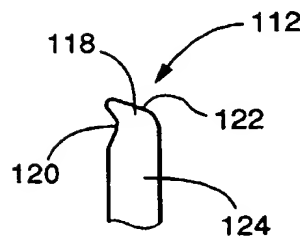


FIG. 15



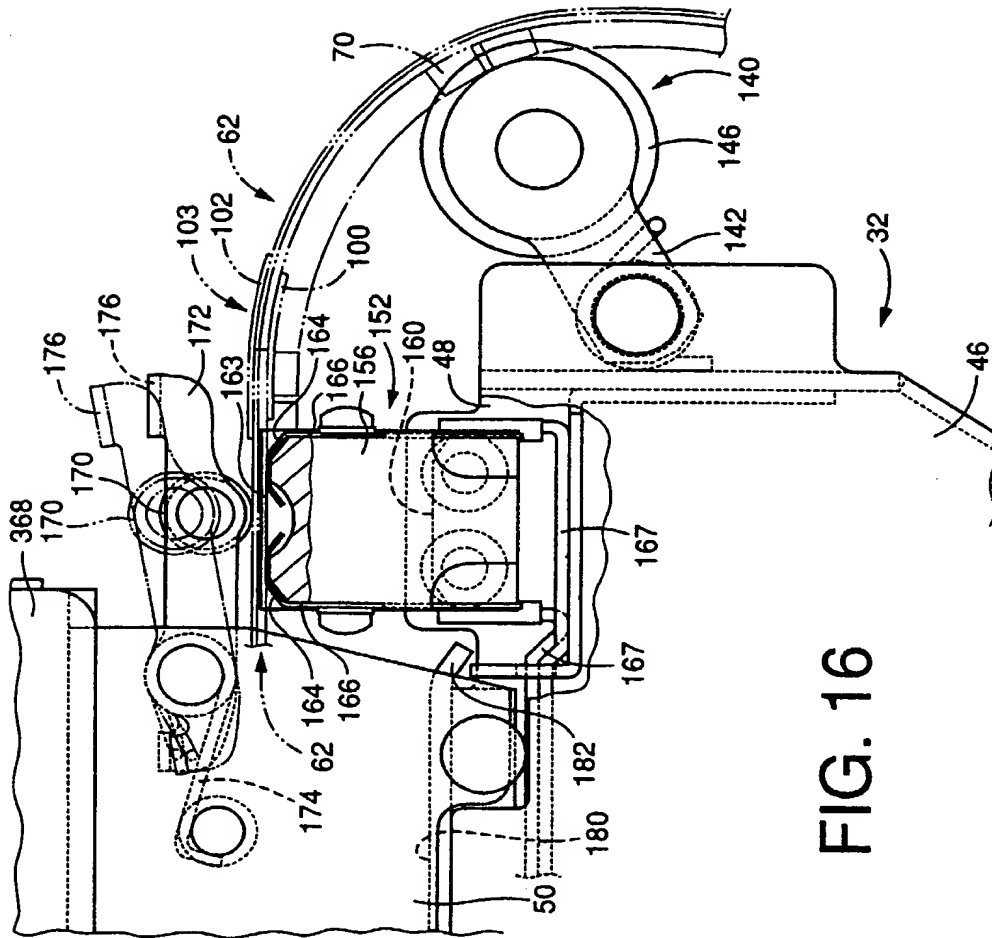


FIG. 16

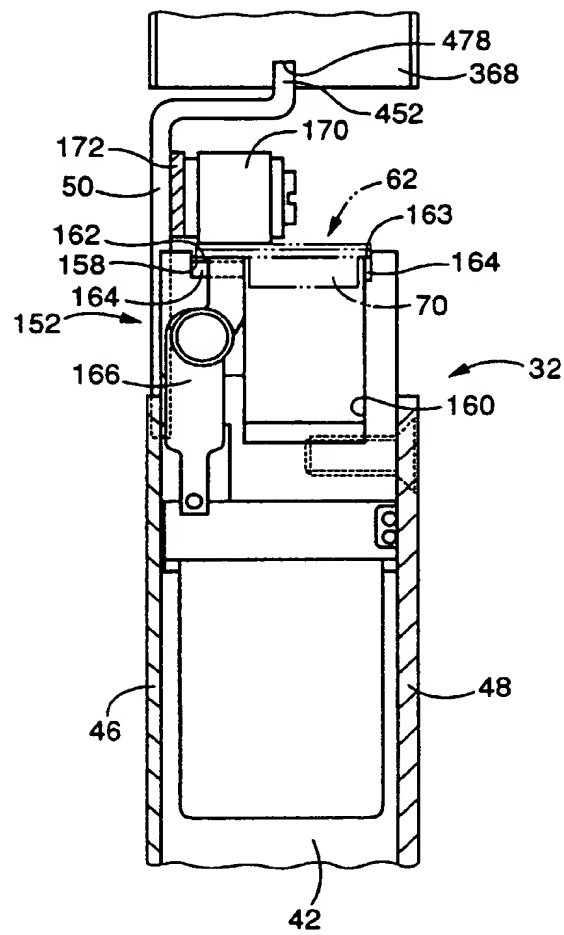


FIG. 17

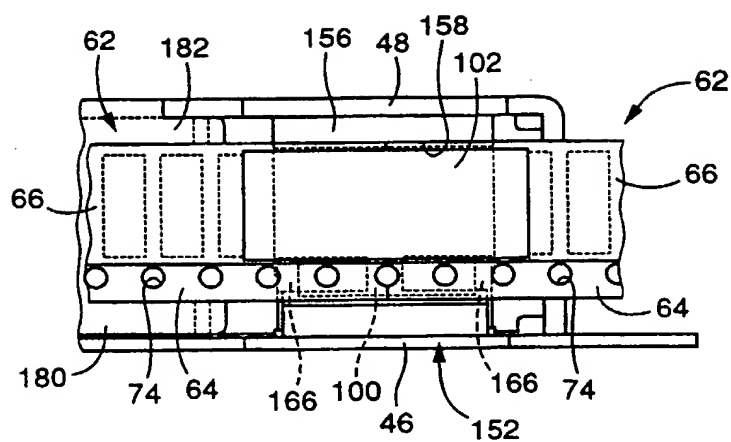


FIG. 18

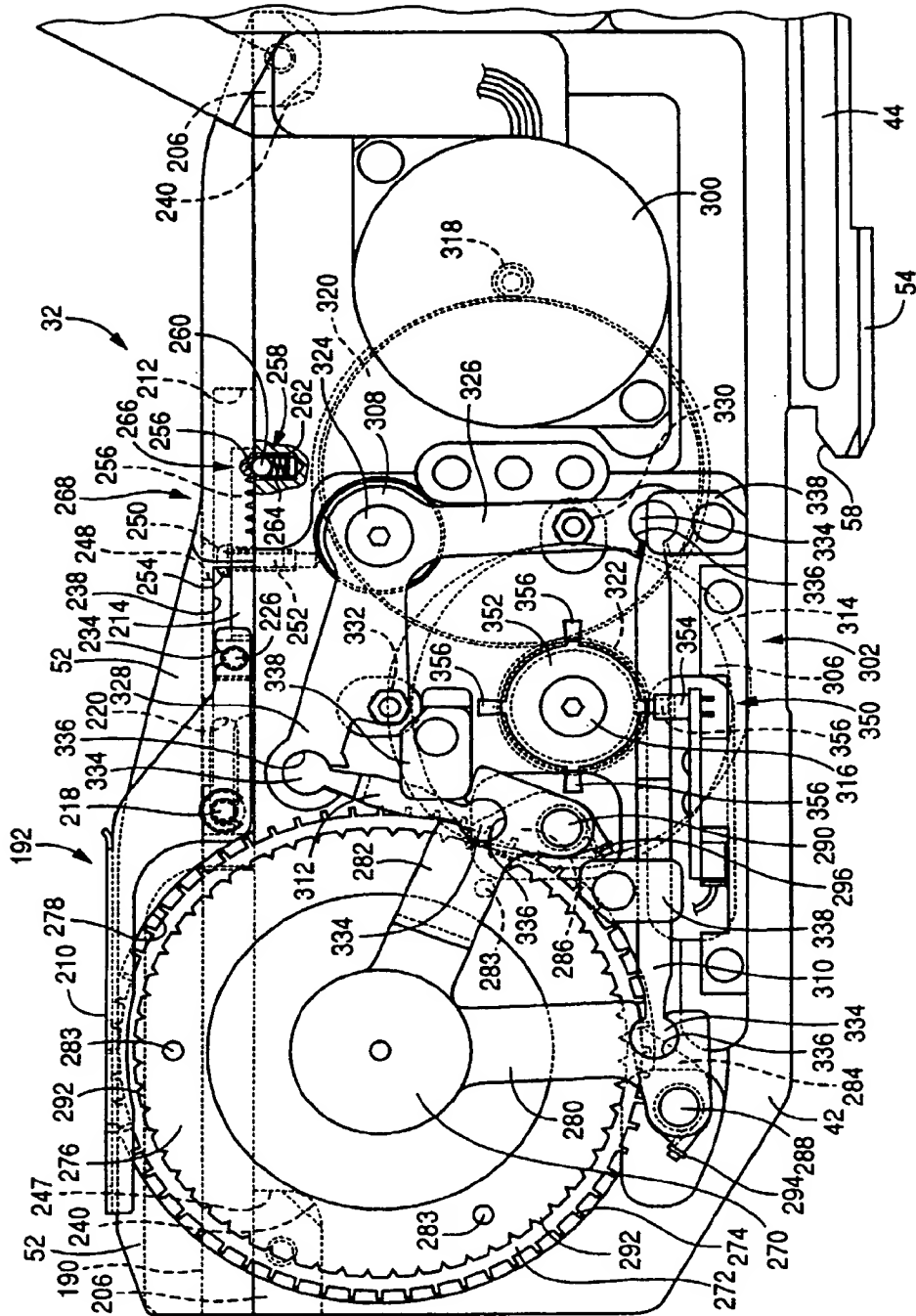


FIG. 19

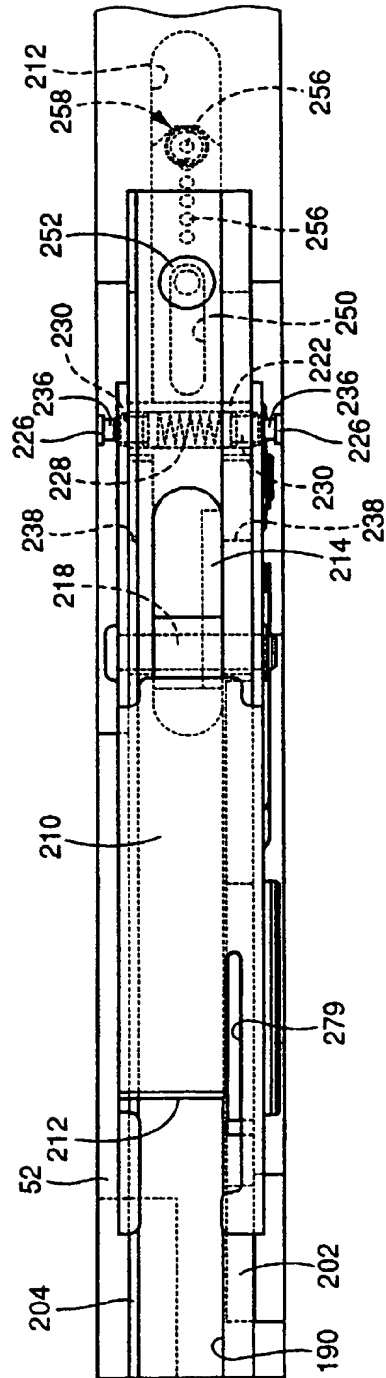


FIG. 20

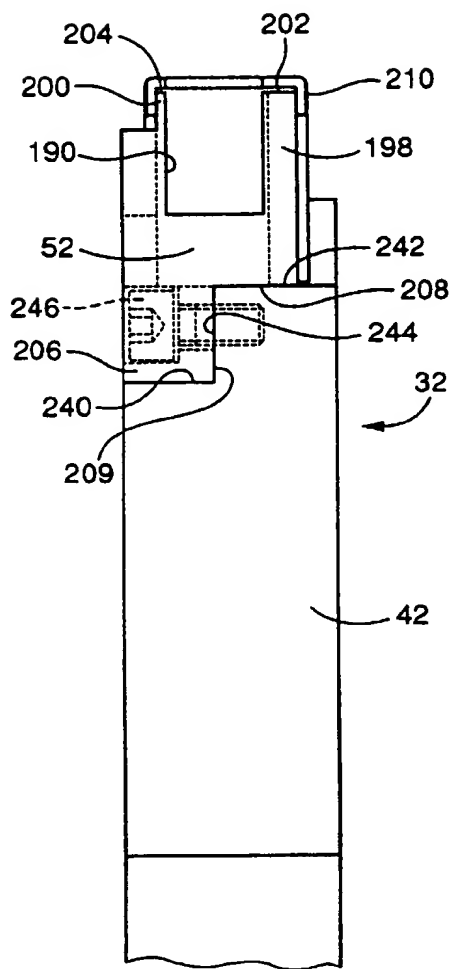


FIG. 21

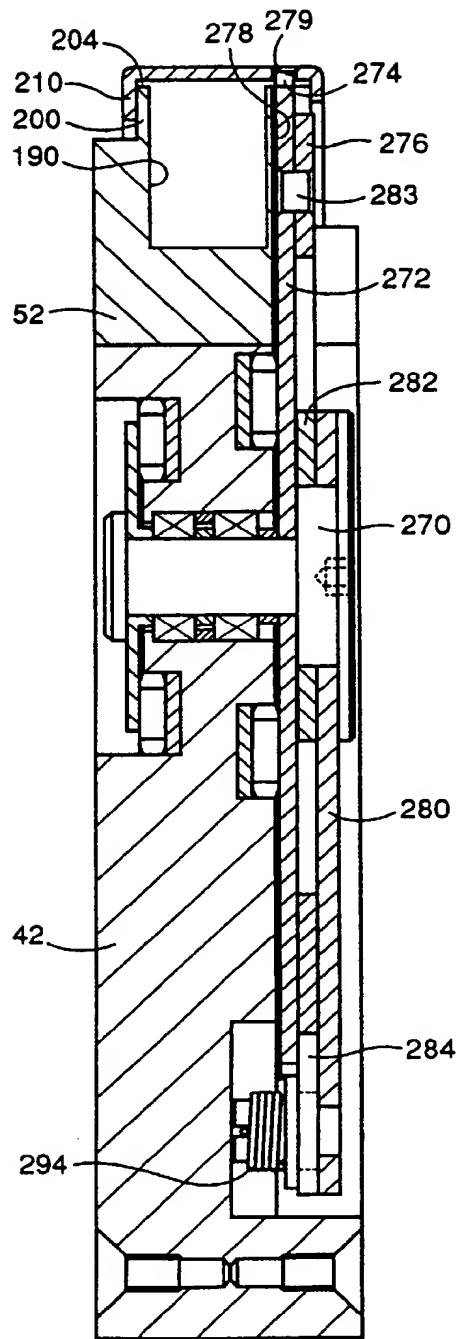


FIG. 22



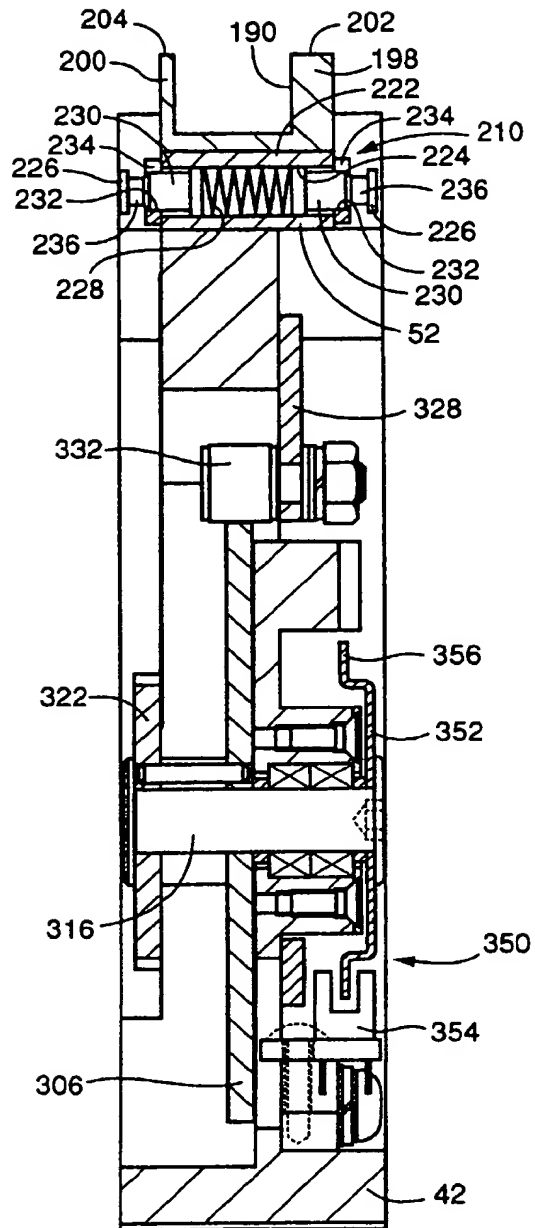


FIG. 23

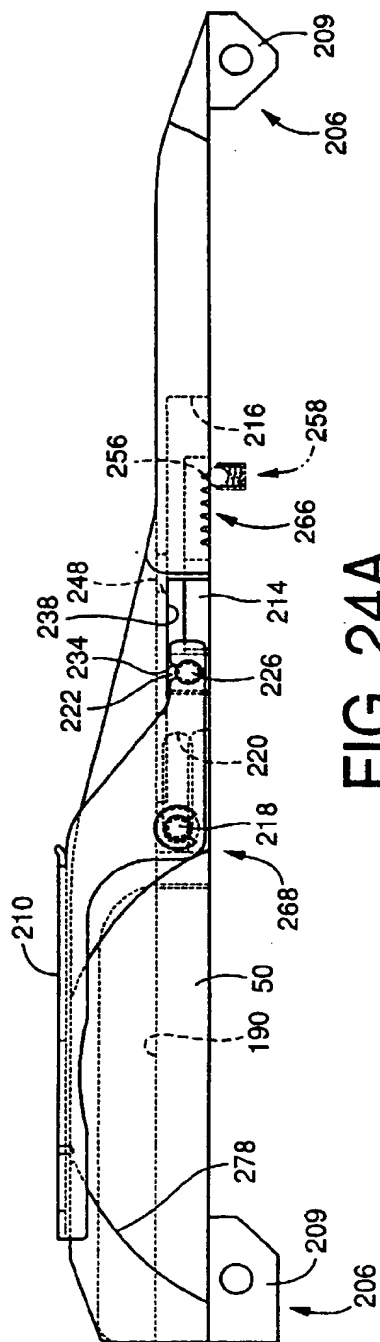


FIG. 24A

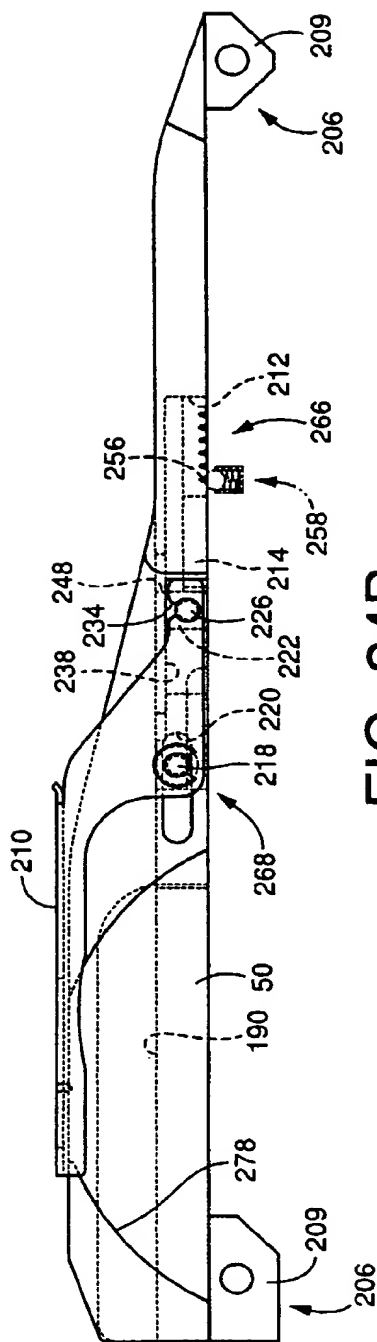


FIG. 24B

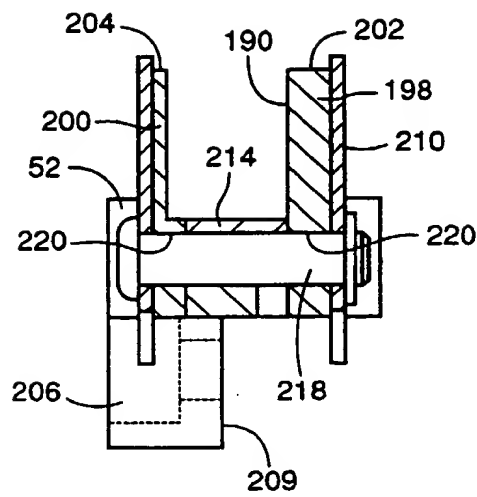


FIG. 25

FIG. 26

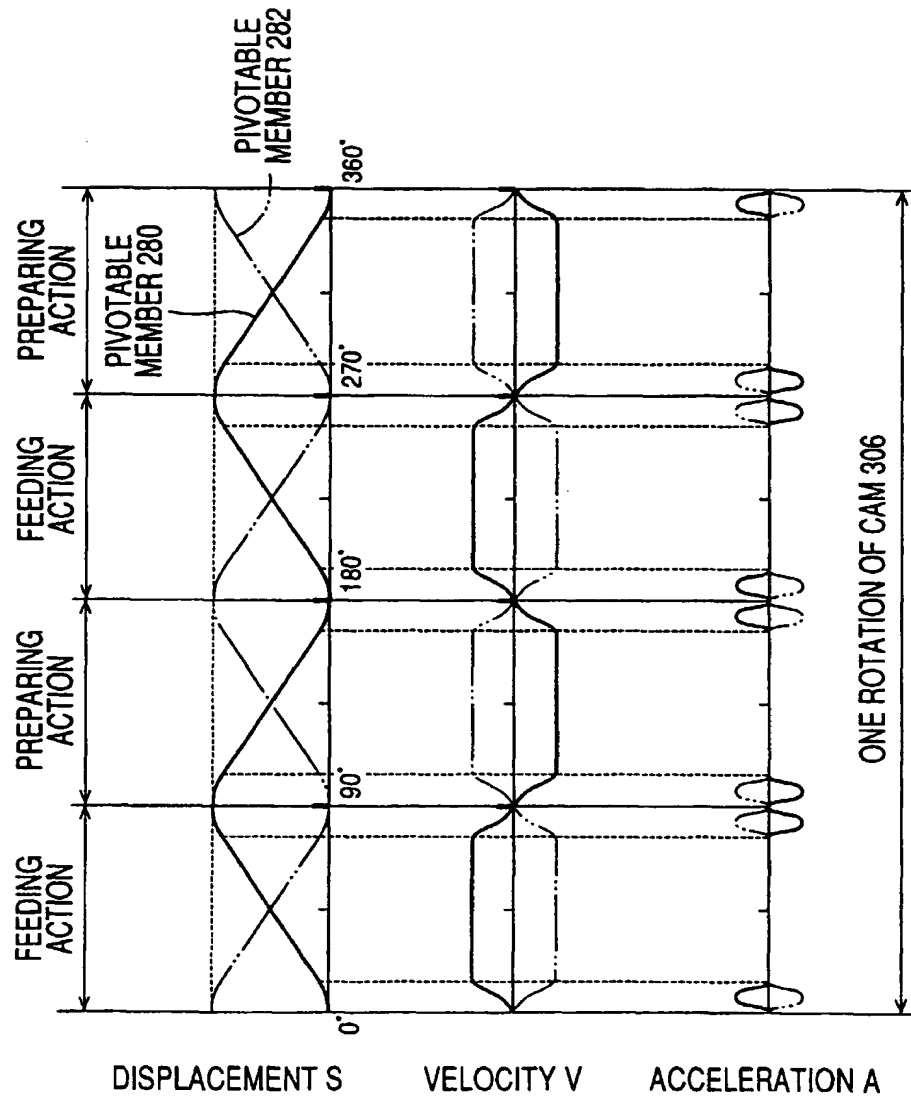
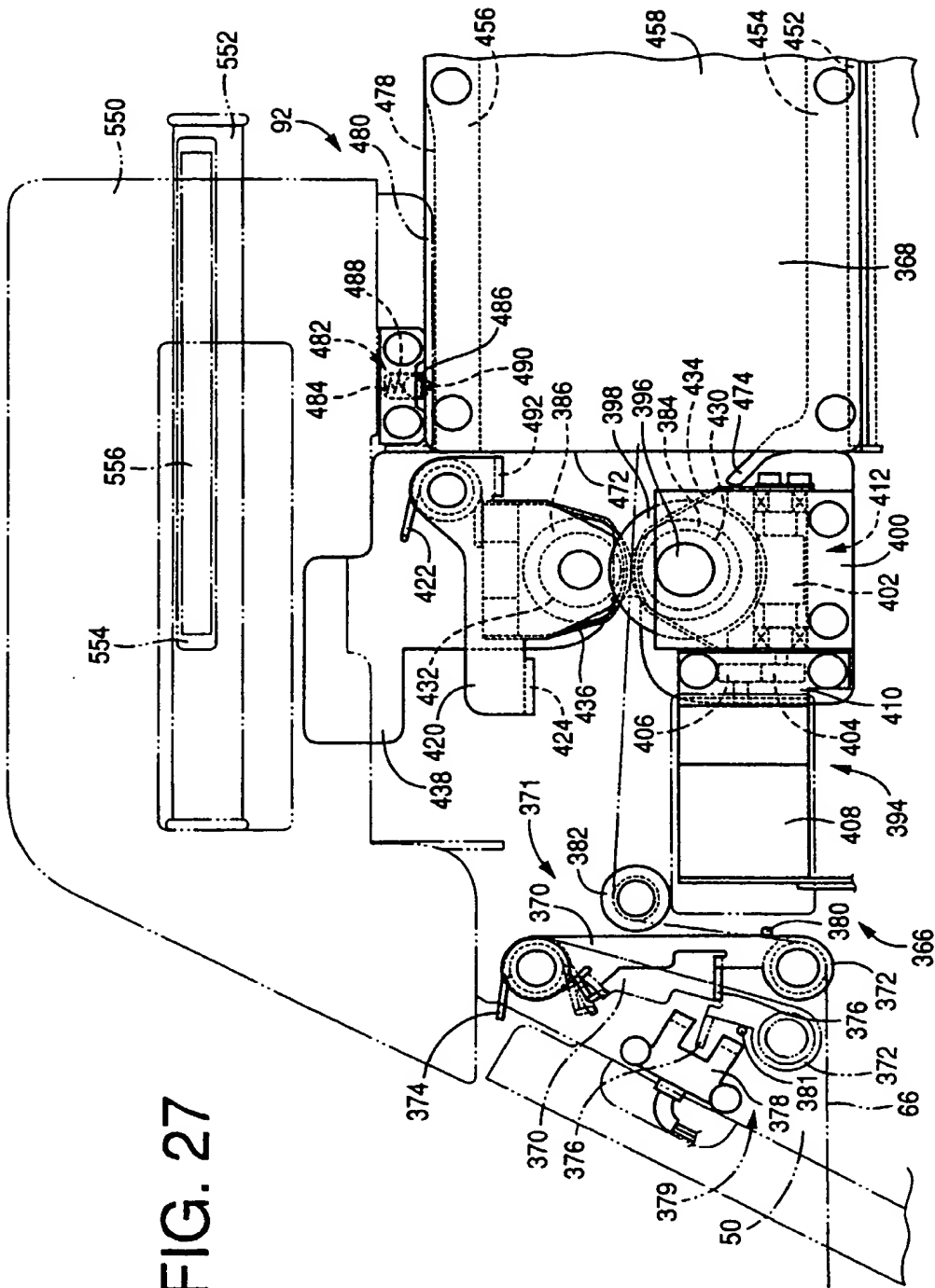


FIG. 27



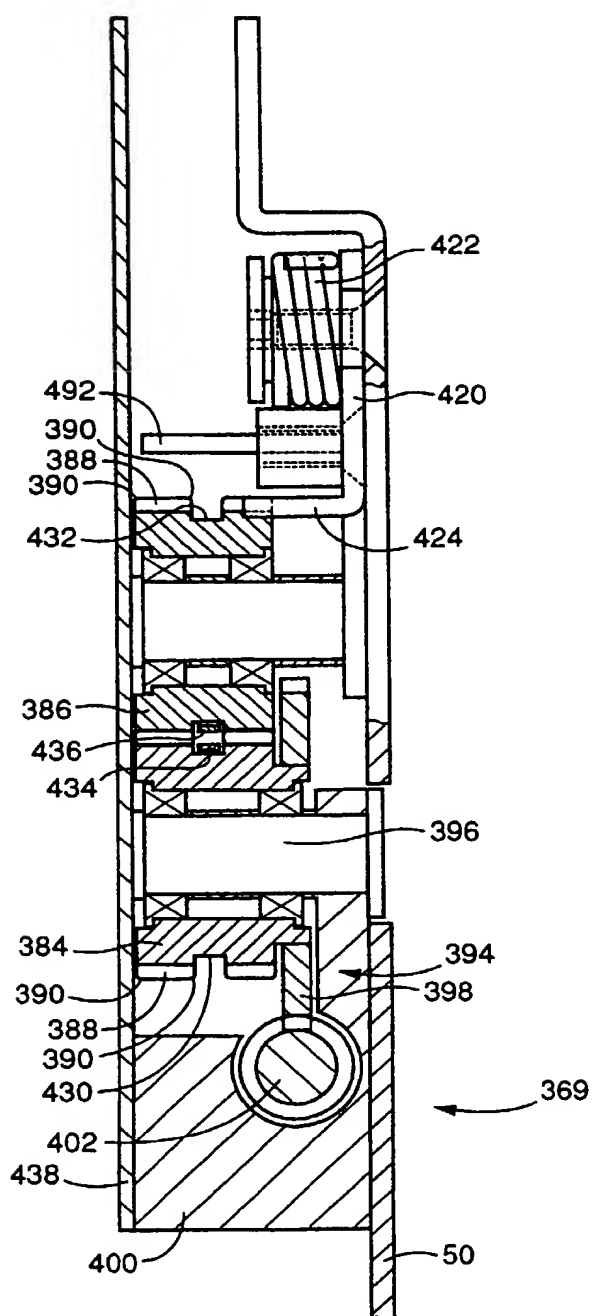


FIG. 28

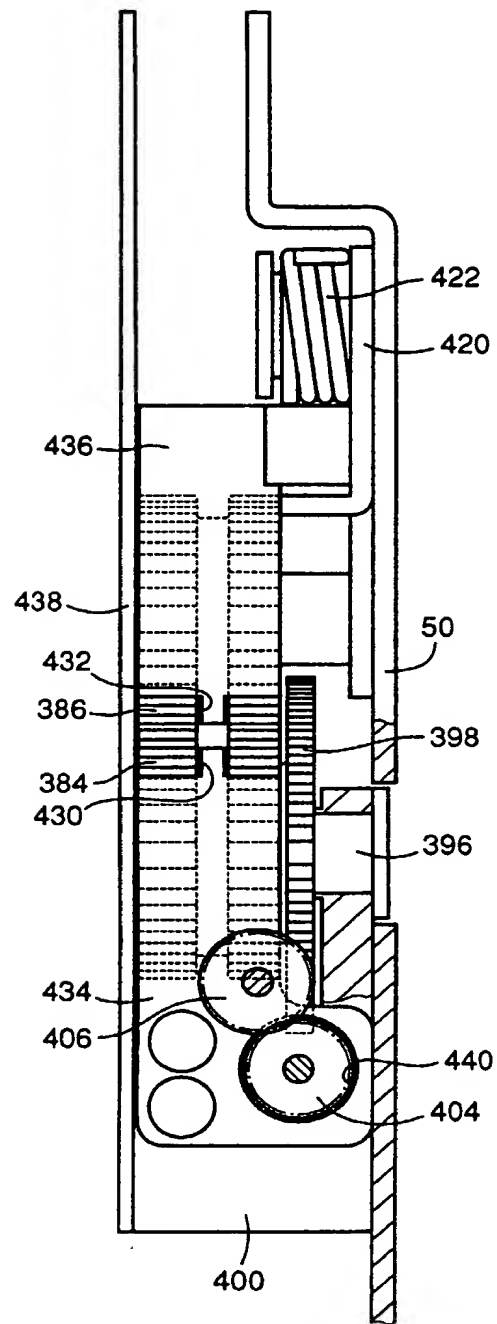


FIG. 29



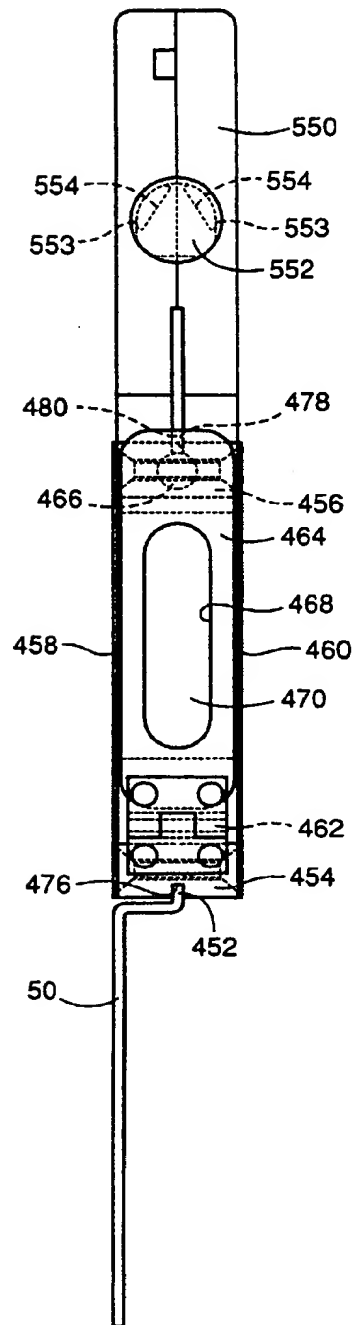


FIG. 30

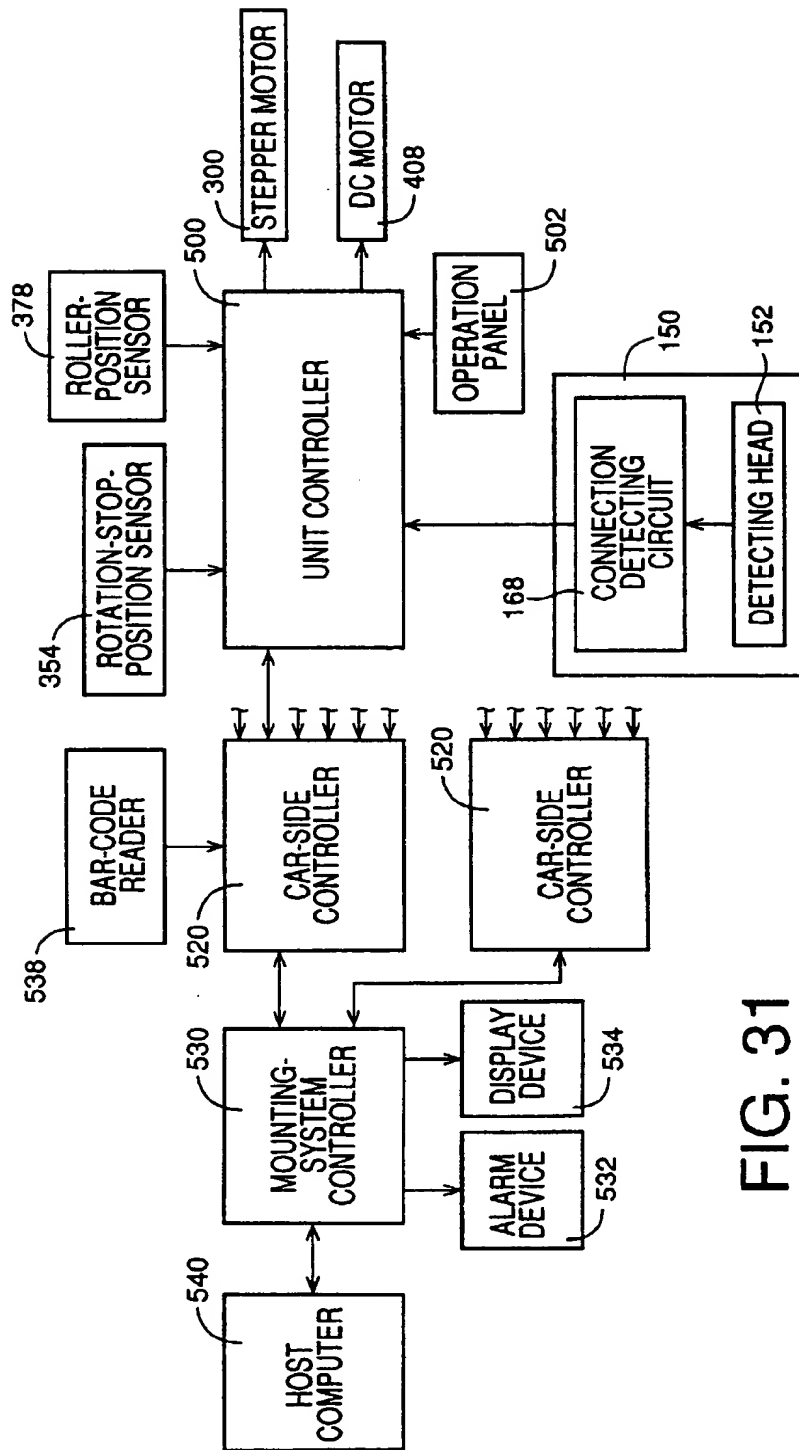


FIG. 31

FIG. 32

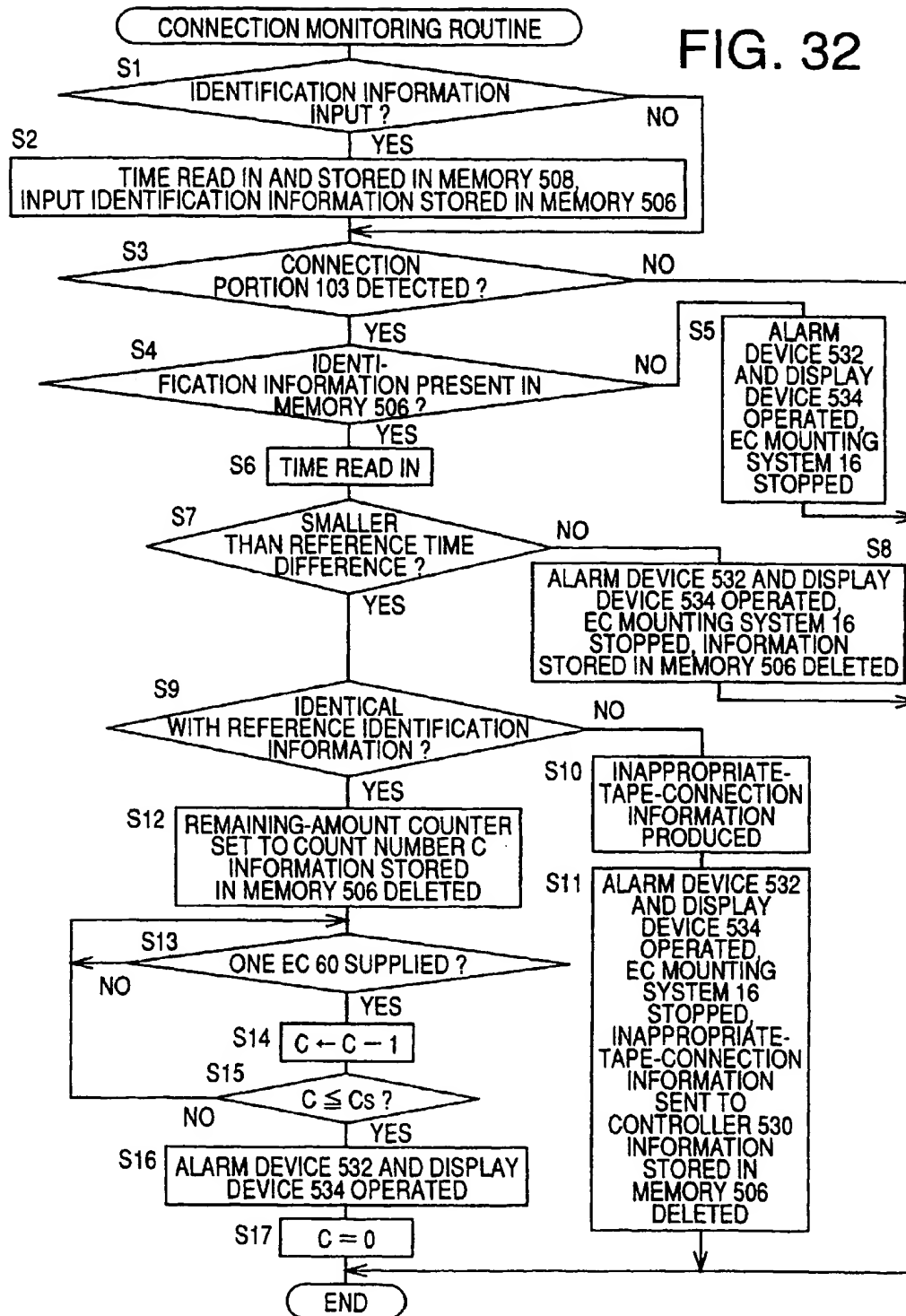
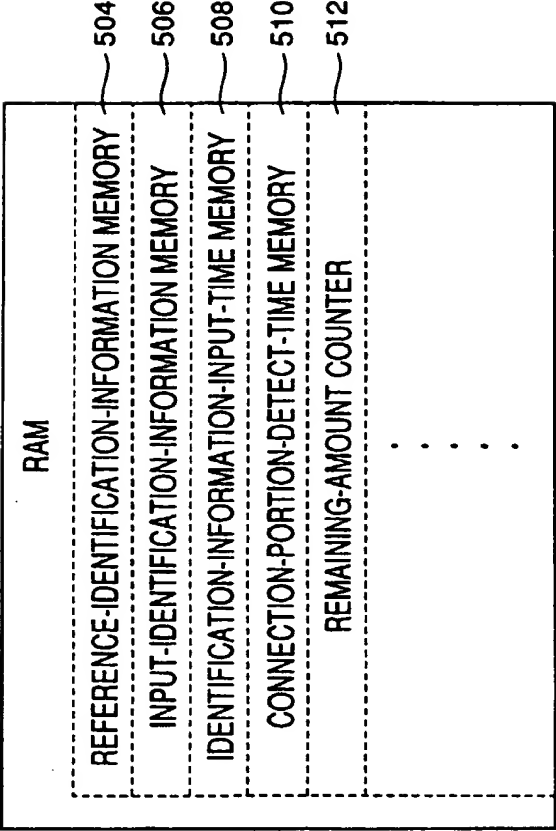


FIG. 33



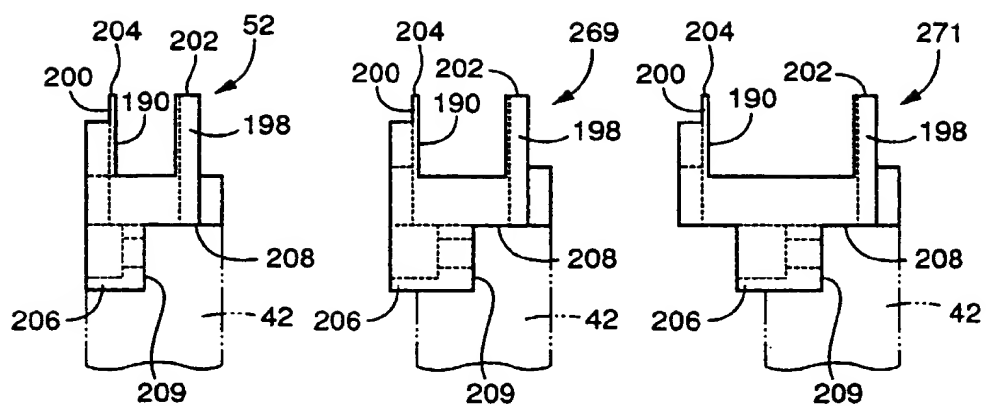


FIG. 34A    FIG. 34B    FIG. 34C

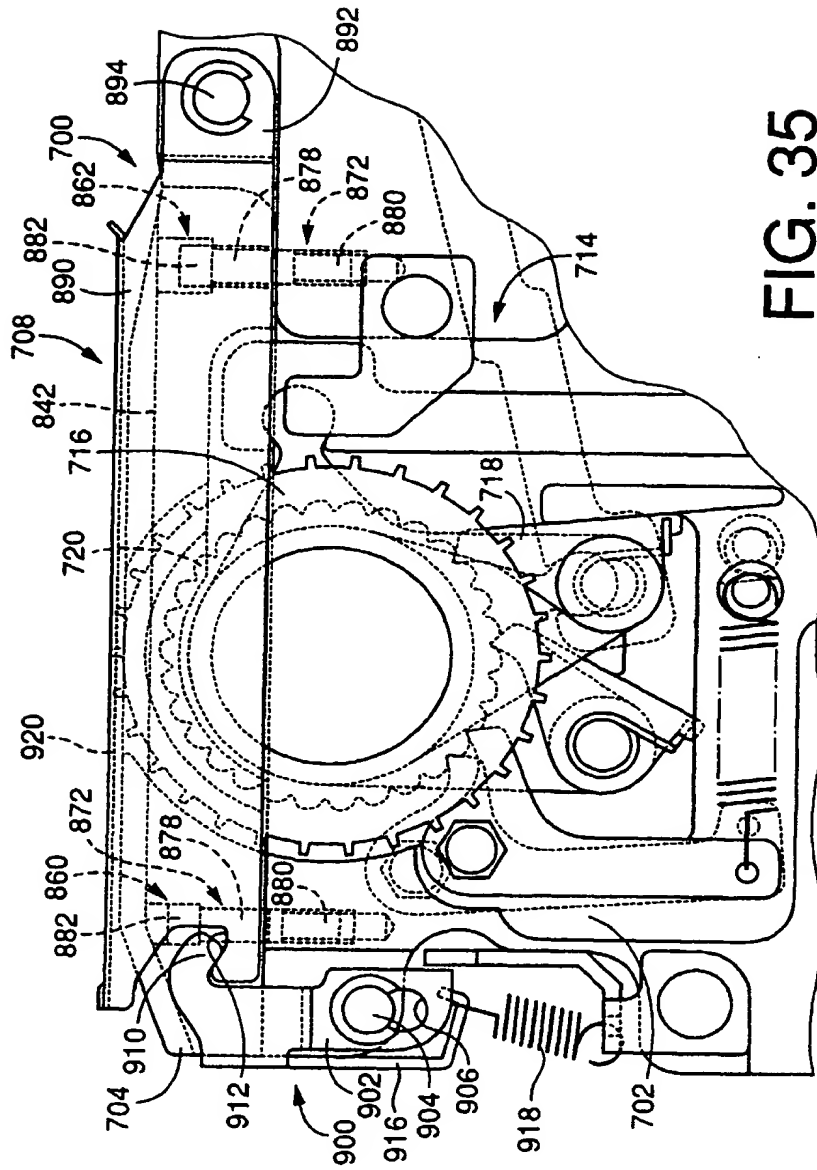


FIG. 35

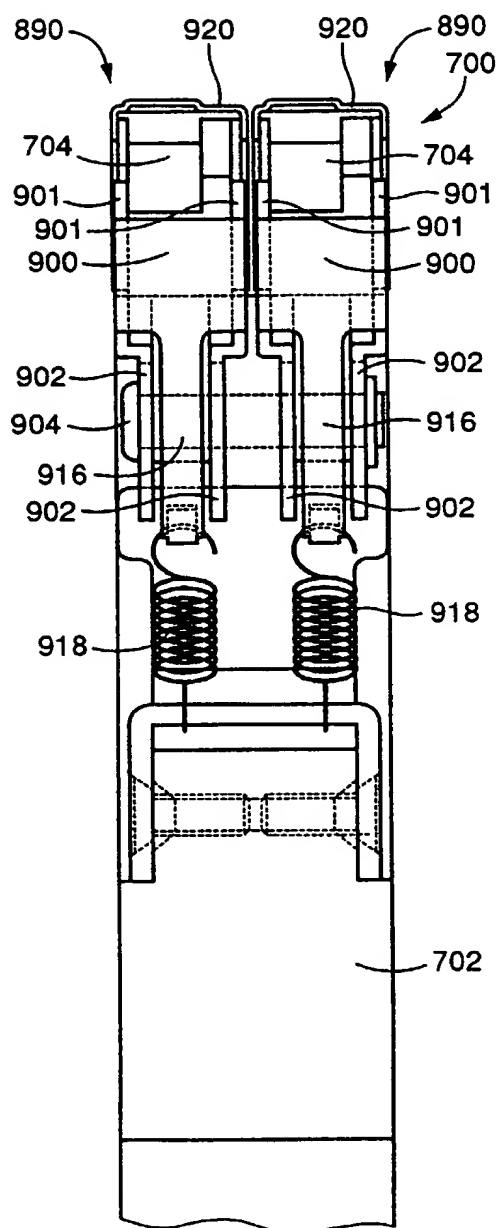


FIG. 36



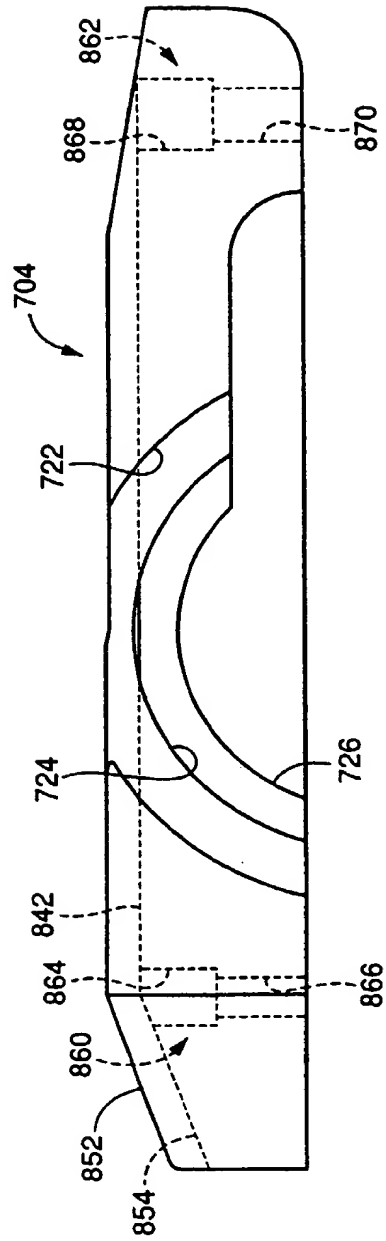


FIG. 37

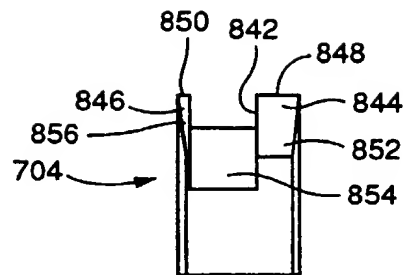


FIG. 38

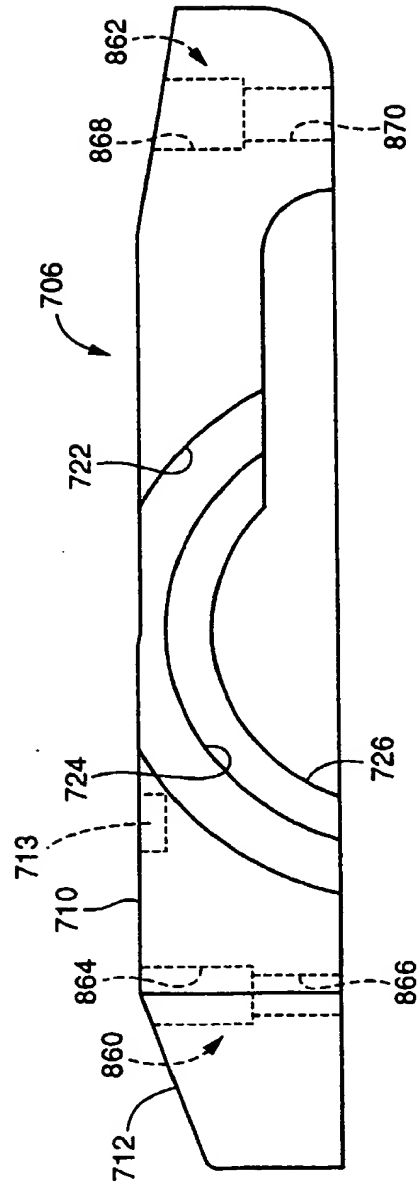


FIG. 39

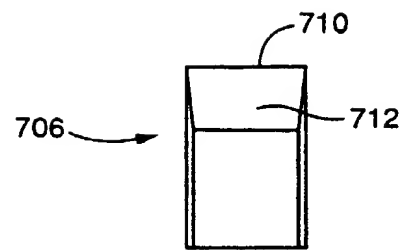


FIG. 40

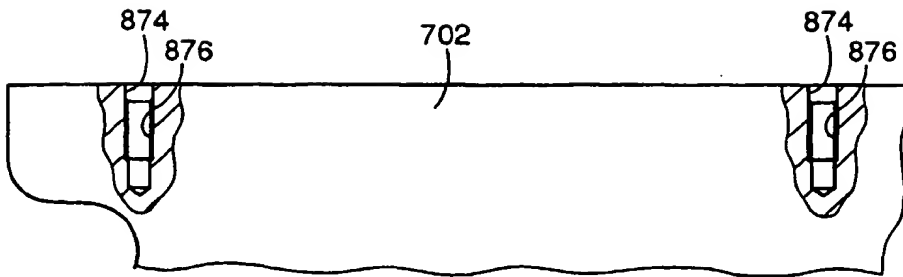


FIG. 41

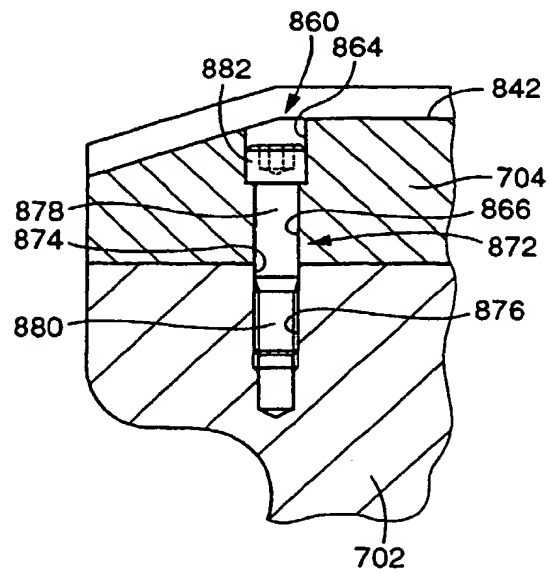


FIG. 42

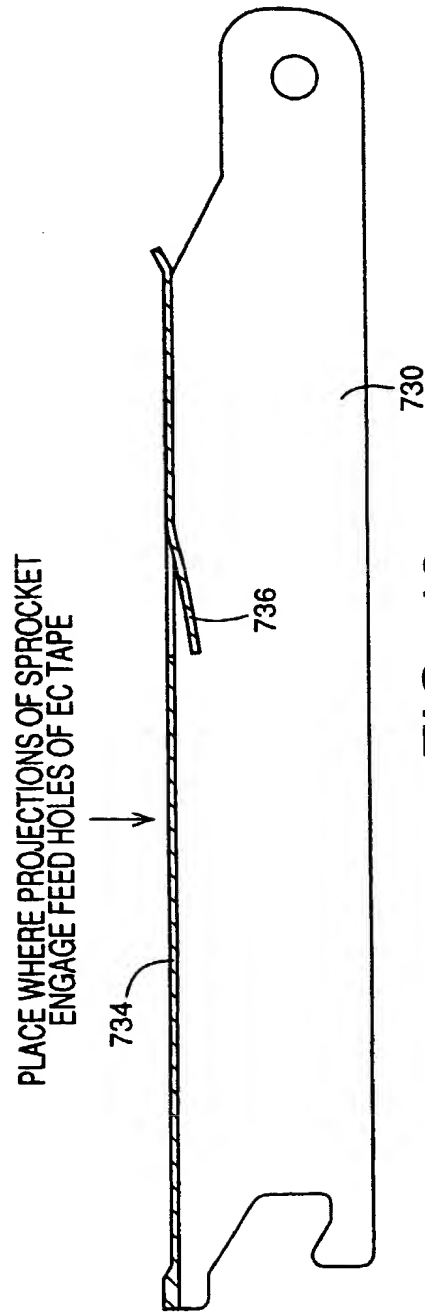


FIG. 43

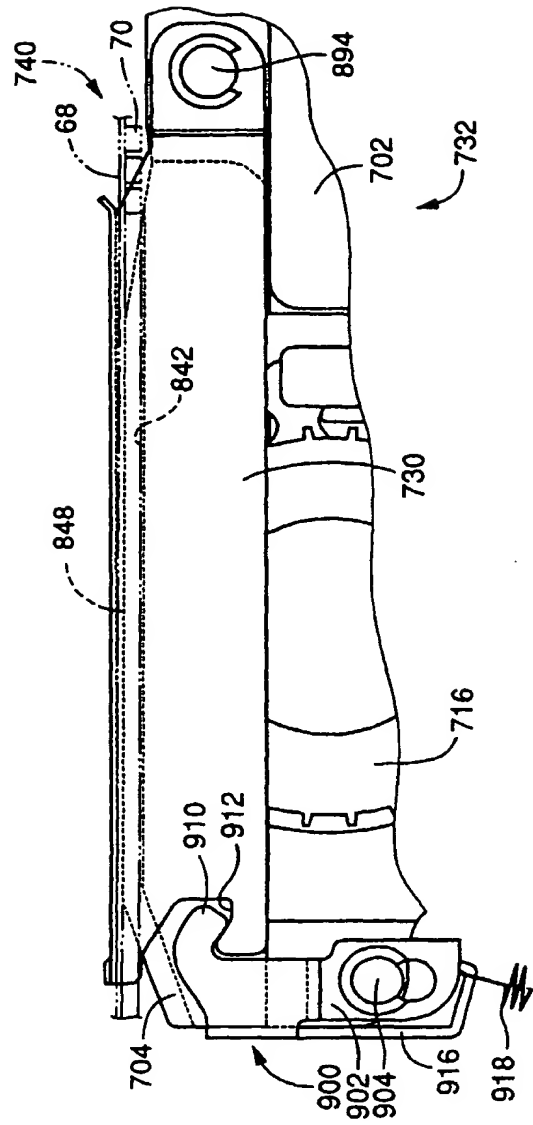


FIG. 44

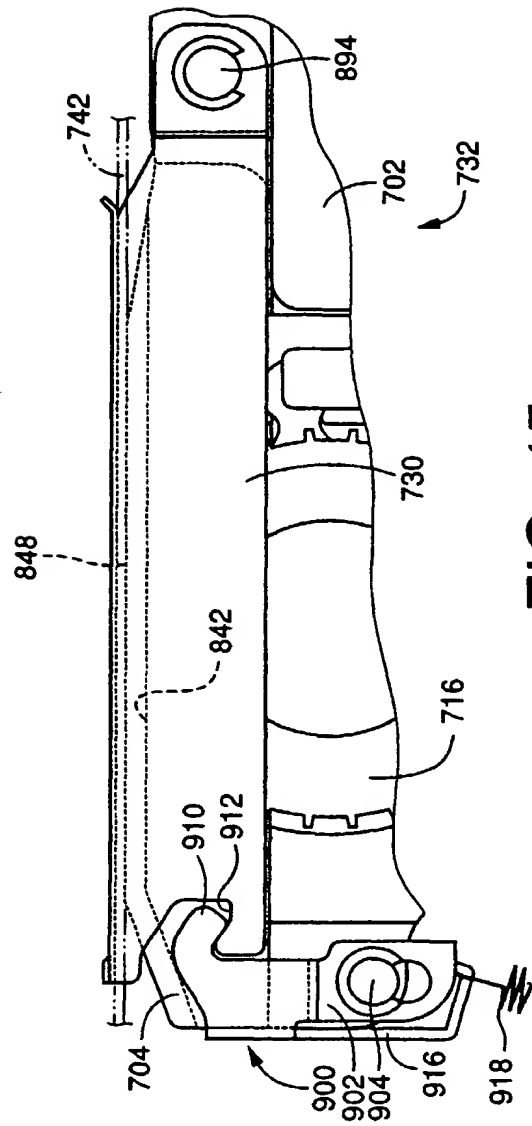


FIG. 45



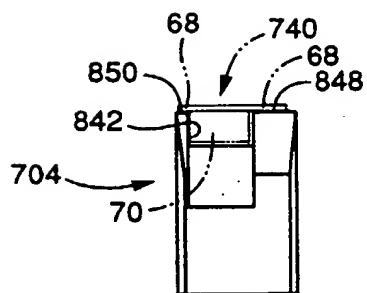


FIG. 46

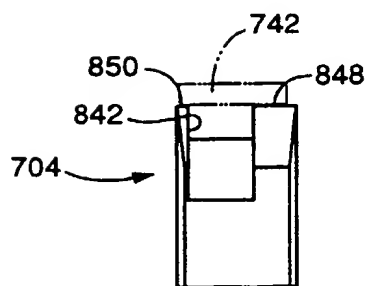


FIG. 47

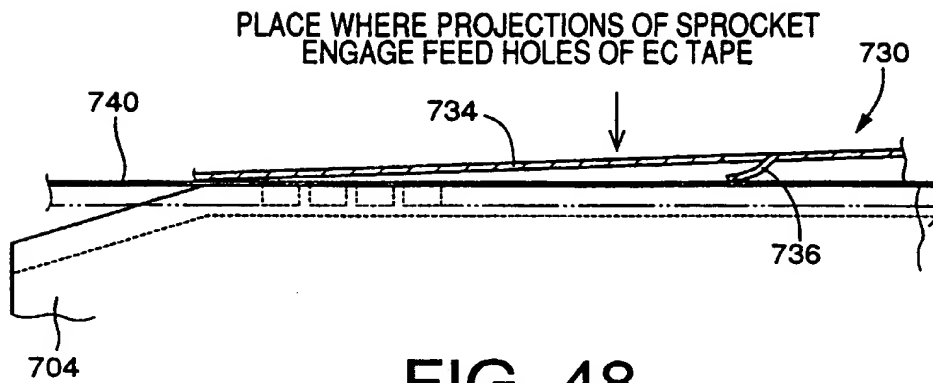


FIG. 48